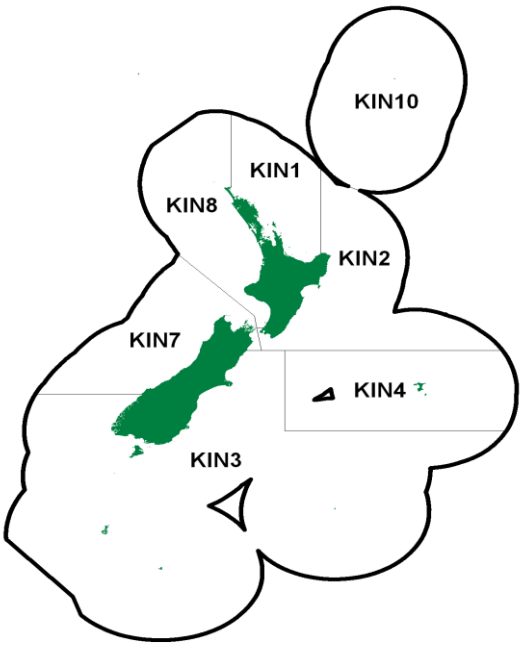
KINGFISH (KIN)

(*Seriola lalandi*)
Haku



1. FISHERY SUMMARY

Kingfish were introduced into the QMS on 1 October 2003, with allowances, TACCs and TACs in Table 1 except that the TACC for KIN 8 was increased from 36 to 45 t in October 2012.

Table 1: Recreational and customary non-commercial allowances, TACCs and TACs by Fishstock.

Fishstock	Recreational Allowance	Customary non-commercial 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	15	21
KIN 8	31	9	7	45	92
KIN 10	1	0	0	1	2

An increased minimum legal size (MLS) to 75 cm (from 65 cm) for recreationally caught kingfish was introduced on 15 January 2004. Kingfish were added to the 6th Schedule of the Fisheries Act (1996) in October 2005 for all fishing methods except setnet and in all areas. A special reporting code for 6th Schedule releases was introduced on 1 October 2006 to allow monitoring of releases. Kingfish released in accordance with 6th Schedule conditions and reported against this code are not counted against ACE. The commercial MLS for kingfish is 65 cm.

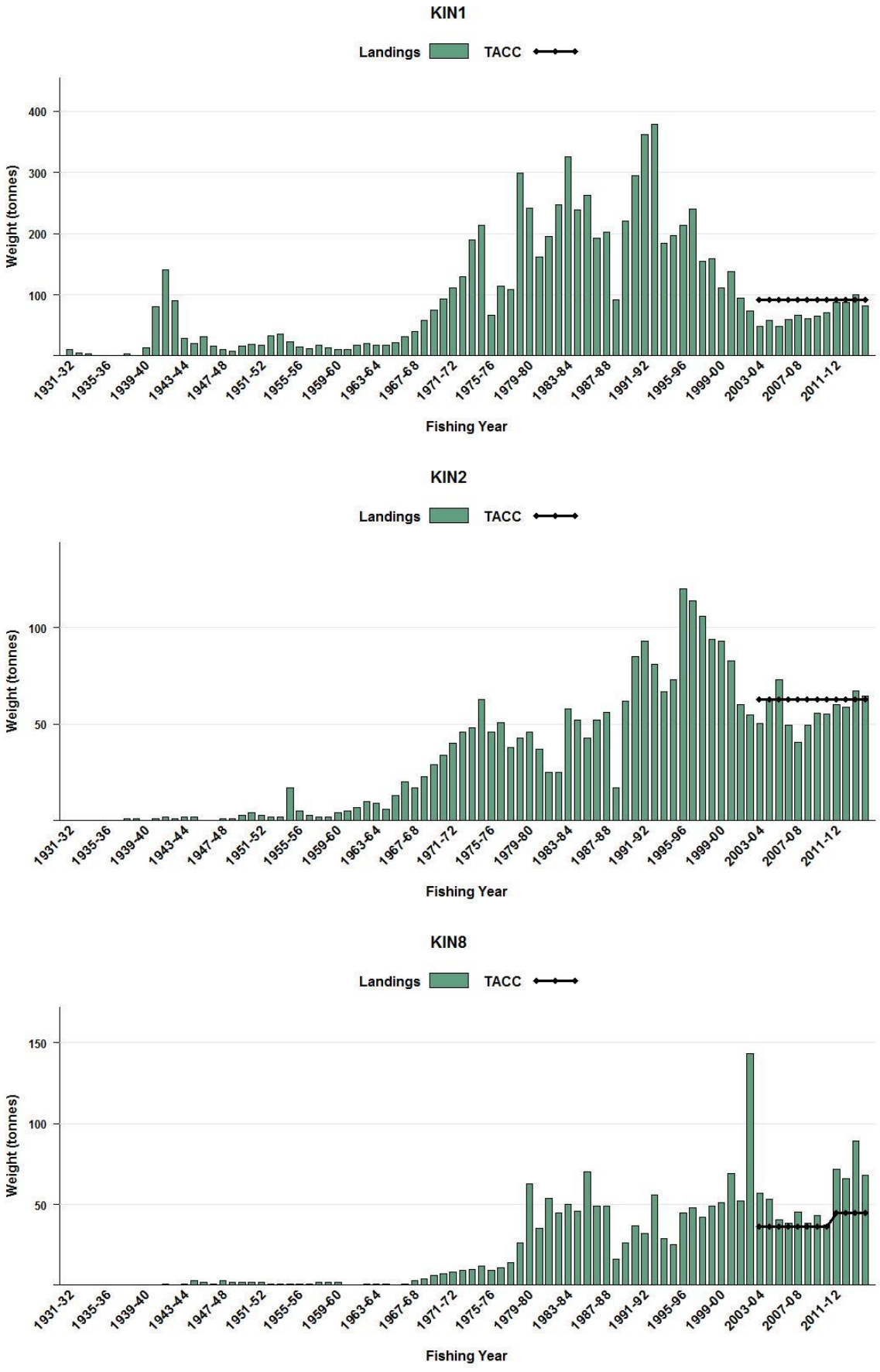


Figure 1: Reported commercial landings and TACC for the three largest KIN stocks. From top to bottom: KIN 1 (Auckland East), KIN 2 (Central East) and KIN 8 (Central Egmont).

1.1 Commercial fisheries

Kingfish commercial landings are reported largely as bycatch 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 fisher's 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.
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, reported 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.

Historical estimated and recent reported kingfish landings and TACCs are shown in Tables 2 and 3, while Figure 1 shows the historical and recent landings and TACC values for the main kingfish stocks.

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 fluctuated between 100 and 250 t from 1993–94 through to 2000–01 and has remained below 100 t since 2001–02. The kingfish annual catch from KIN 2 declined from the high of 120 t in 1995–96 to 50 t in 2003–04, and has mostly been below 60 t since then. 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 were still above the TACC. Annual catches in KIN 8 have remained below 50 t since 2005–06, but were often above the 36 t TACC Although the TACC was increased to 45 t in October 2011 to accommodate previous levels of by-catch, the 2011–12 commercial catch increased substantially to 92 t. In addition to annual catches reported for kingfish QMAs, about 5 t of kingfish has been taken by New Zealand flagged vessels fishing outside NZ fishing waters.

Assuming that kingfish targeting effectively ceased during the mid 1990s, catches since the early 2000s possibly reflect 'true' bycatch levels.

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

Year	KIN 1	KIN 2	KIN 8	Year	KIN 1	KIN 2	KIN 8
1931–32	10	0	0	1957	18	2	2
1932–33	5	0	0	1958	13	2	2
1933–34	3	0	0	1959	10	4	2
1934–35	1	0	0	1960	11	5	0
1935–36	0	0	0	1961	18	7	0
1936–37	0	0	0	1962	20	10	1
1937–38	3	1	0	1963	18	9	1
1938–39	1	1	0	1964	18	6	1
1939–40	13	0	0	1965	21	13	0
1940–41	80	1	0	1966	32	20	1
1941–42	141	2	1	1967	40	17	3
1942–43	90	1	0	1968	58	23	4
1943–44	28	2	1	1969	75	29	6
1944	20	2	3	1970	93	34	7
1945	31	0	2	1971	111	40	8
1946	16	0	1	1972	129	46	9
1947	11	1	3	1973	189	48	10
1948	8	1	2	1974	214	63	12
1949	16	3	2	1975	66	46	9
1950	19	4	2	1976	114	51	11
1951	17	3	2	1977	109	38	14
1952	33	2	1	1978	299	43	26
1953	35	2	1	1979	242	46	63
1954	23	17	1	1980	161	37	35
1955	14	5	1	1981	195	25	54
1956	12	3	1	1982	247	25	45

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 includes both foreign and domestic landings.

Table 3: Reported landings (t) of kingfish by area (QMA) from 1983–84 to 2014–15. 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. MHR data from 2001–present. [Continued on next page].

Year		KIN 1		KIN 2		KIN 3		KIN 4
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1983–84*	326	-	58	-	11	-	0	-
1984–85*	239	-	52	-	8	-	0	-
1985–86*	262	-	43	-	4	-	0	-
1986–87	192	-	52	-	9	-	0	-
1987–88	202	-	56	-	9	-	0	-
1988–89	92	-	17	-	4	-	0	-
1989–90	221	-	62	-	2	-	0	-
1990–91	295	-	85	-	6	-	< 1	-
1991–92	362	-	93	-	4	-	< 1	-
1992–93	378	-	81	-	4	-	0	-
1993–94	184	-	67	-	2	-	< 1	-
1994–95	196	-	73	-	2	-	0	-
1995–96	214	-	120	-	2	-	< 1	-
1996–97	240	-	114	-	7	-	< 1	-
1997–98	155	-	106	-	2	-	< 1	-
1998–99	159	-	94	-	3	-	< 1	-
1999–00	111	-	93	-	4	-	< 1	-
2000–01	138	-	83	-	4	-	< 1	-
2001–02	95	-	60	-	2	-	< 1	-
2002–03	73	-	55	-	1	-	0	-
2003–04	49	91	50	63	1	1	< 1	1
2004–05	58	91	63	63	1	1	0	1
2005–06	48	91	73	63	< 1	1	0	1
2006–07	60	91	50	63	1	1	0	1
2007–08	66	91	40	63	< 1	1	< 1	1
2008–09	61	91	50	63	< 1	1	< 1	1
2009–10	66	91	56	63	< 1	1	< 1	1
2010–11	71	91	55	63	< 1	1	< 1	1
2011–12	87	91	60	63	< 1	1	< 1	1
2012–13	88	91	59	63	2	1	<1	1
2013–14	100	91	67	63	1	1	<1	1
2014–15	81	91	64	63	1	1	<!	1

Table 3 [Continued]

Year		KIN 7		KIN 8		KIN 10		Total
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1983–84*	3	-	50	-	0	-	448	-
1984–85*	< 1	-	46	-	0	-	345	-
1985–86*	1	-	70	-	0	-	380	-
1986–87	1	-	49	-	0	-	356	-
1987–88	1	-	49	-	0	-	373	-
1988–89	< 1	-	16	-	0	-	460	-
1989–90	3	-	§26	-	< 1	-	428	-
1990–91	2	-	§37	-	< 1	-	448	-
1991–92	2	-	§32	-	9	-	512	-
1992–93	1	-	§56	-	< 1	-	532	-
1993–94	4	-	29	-	< 1	-	288	-
1994–95	6	-	25	-	< 1	-	302	-
1995–96	7	-	45	-	< 1	-	380	-
1996–97	11	-	48	-	6	-	427	-
1997–98	7	-	42	-	1	-	326	-
1998–99	16	-	49	-	< 1	-	323	-
1999–00	10	-	51	-	0	-	270	-
2000–01	11	-	69	-	< 1	-	304	-
2001–02	22	-	52	-	0	-	231	-
2002–03	20	-	143	-	0	-	292	-
2003–04	3	7	57	36	0	1	160	200
2004–05	19	7	53	36	0	1	195	200
2005–06	7	7	40	36	< 1	1	169	200
2006–07	13	7	39	36	0	1	161	200
2007–08	5	7	45	36	0	1	157	200
2008–09	5	7	38	36	0	1	154	200
2009–10	7	7	43	36	0	1	172	200
2010–11	6	7	37	36	0	1	171	200
2011–12	15	7	72	45	0	1	235	209
2012–13	12	7	66	45	0	1	226	209
2013–14	26	15	89	45	0	1	283	217
2014–15	20	15	68	45	0	1	235	217

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

1.2 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 shore based game fishers. Kingfish are recognized internationally as a sport fish, and kingfish caught in New Zealand waters hold 21 of the 22 International Gamefish Association World Records.

1.2.1 Management controls

The main methods used to manage recreational harvests of kingfish are minimum legal size limits (MLS), method restrictions and daily bag limits. Fishers can take up to three kingfish as part their daily bag limit and the MLS is 75 cm.

Recreational fishers have voiced concerns over the reduced availability of large kingfish in some areas. Many clubs, competitions and charter boats have consequently 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.

1.2.2 Tag and release

A voluntary recreational tagging programme has released 21 932 kingfish in New Zealand (1975 to 2015). Anglers feel they are contributing to research and conservation of stocks, while still getting recognition of their catch. The research objectives are to collect detailed information on released fish to help characterise the fishery and collect growth and movement information from recaptured fish. There have been 1495 tagged kingfish recaptured in New Zealand (1977 to 2015), with an average of 43 recaptures (and 787 releases) per year over the last 10 years (Table 4).

Table 4: The number of kingfish tagged and recaptured by year for the last 10 years.

	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15
Releases	1 016	977	1 120	661	1 381	1123	613	761	649	722
Recaptures	53	38	55	43	46	54	44	38	31	30

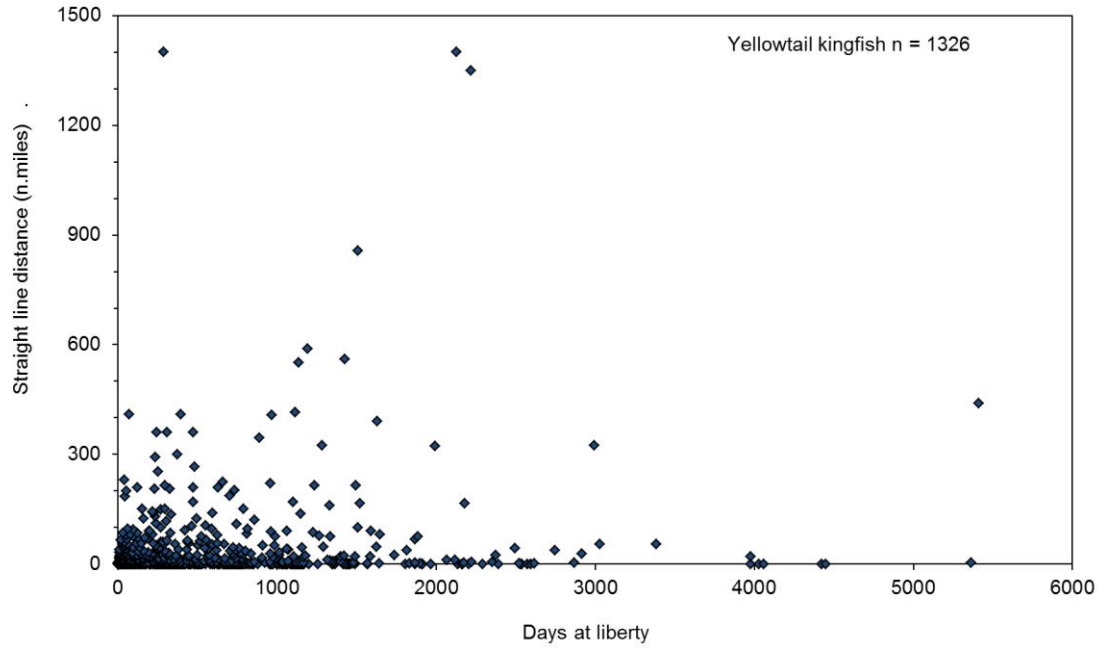


Figure 2: Kingfish straight line distance from release location by days at liberty 1977 to 2013.

Most kingfish are caught close to their release location even after many years. Ninety four percent of recaptures for fish at liberty for 30 days or more were within 100 nautical miles of the release point (Figure 2). The proportion of recaptured kingfish at distances (over 100 miles) increases after 3 years. Kingfish are also capable of extensive movements with three trans-Tasman recaptures recorded.

1.2.3 Estimates of recreational harvest

Recreational catch estimates are given in Table 5. There are two broad approaches to estimating recreational fisheries harvest: the use of onsite or access point methods where fishers are surveyed or counted at the point of fishing or access to their fishing activity; and, offsite methods where some form of post-event interview and/or diary are used to collect data from fishers.

The first estimates of recreational harvest for kingfish were calculated using an offsite approach, the offsite regional telephone and diary survey approach. Estimates for 1996 came from a national telephone and diary survey (Bradford 1998). Another national telephone and diary survey was carried out in 2000 (Boyd & Reilly 2005) and a rolling replacement of diarists in 2001 (Boyd & Reilly 2004 allowed estimates for a further year (population scaling ratios and mean weights were not re-estimated in 2001).

The harvest estimates provided by these telephone diary surveys are no longer considered reliable for various reasons. With the early telephone/diary method, fishers were recruited to fill in diaries by way of a telephone survey that also estimates the proportion of the population that is eligible (likely to fish). A "soft refusal" bias in the eligibility proportion arises if interviewees who do not wish to co-operate falsely state that they never fish. The proportion of eligible fishers in the population (and, hence, the harvest) is thereby under-estimated. Pilot studies for the 2000 telephone/diary survey suggested that this effect could occur when recreational fishing was established as the subject of the interview at the outset. Another equally serious cause of bias in telephone/diary surveys was that diarists who did not immediately record their day's catch after a trip

sometimes overstated their catch or the number of trips made. There is some indirect evidence that this may have occurred in all the telephone/diary surveys (Wright et al 2004).

The recreational harvest estimates provided by the 2000 and 2001 telephone diary surveys are thought to be implausibly high for many species, which led to the development of an alternative maximum count aerial-access onsite method that provides a more direct means of estimating recreational harvests for suitable fisheries. The maximum count aerial-access approach combines data collected concurrently from two sources: a creel survey of recreational fishers returning to a subsample of boat ramps throughout the day; and an aerial survey count of vessels observed to be fishing at the approximate time of peak fishing effort on the same day. The ratio of the aerial count in a particular area to the number of interviewed parties who claimed to have fished in that area at the time of the overflight was used to scale up harvests observed at surveyed ramps, to estimate harvest taken by all fishers returning to all ramps. The methodology is further described by Hartill et al (2007).

This aerial-access method was first employed and optimised to estimate snapper harvests in the Hauraki Gulf in 2003–04. It was then extended to survey the wider SNA 1 fishery in 2004–05 and to provide estimates for other species, including kingfish. The PELWG indicated that the kingfish 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.

Table 5: Recreational harvest estimates for kingfish stocks. The telephone/diary surveys ran from December to November but are denoted by the January calendar year. The national panel survey ran through the October to September fishing year but is denoted by the January calendar year. Mean fish weights were obtained from boat ramp surveys (for the telephone/diary and panel survey harvest estimates). (Source: Tierney et al 1997, Bradford 1997, Bradford 1998, Boyd & Reilly 2002, Boyd et al. 2004, Wynne-Jones et. al 2014).

Stock	Year	Method	Number of fish	Total weight (t)	CV
KIN 1	1992	Telephone/diary	186 000	260	-
	1994	Telephone/diary	180 000	228#	0.09
	1996	Telephone/diary	194 000	234	0.07
	2000	Telephone/diary	127 000	800	0.18
	2001	Telephone/diary	109 000	683	0.17
	2012	Panel survey	52 056	535	0.13
KIN 2	1992	Telephone/diary	68 000	92	-
	1994	Telephone/diary	62 000	78	0.18
	1996	Telephone/diary	67 000	70	0.11
	2000	Telephone/diary	25 000	138	0.38
	2001	Telephone/diary	21 000	113	0.33
	2012	Panel survey	4 025	41	0.24
KIN 7	1992	Telephone/diary	10 000	20	-
	1994	Telephone/diary	-	-	-
	1996	Telephone/diary	9 000	13	0.19
	2000	Telephone/diary	2 000	11	0.55
	2001	Telephone/diary	1 000	9	0.86
	2012	Panel survey	2 079	21	0.38
KIN 8	1992	Telephone/diary	6 000	7.6#	-
	1994	Telephone/diary	-	-	-
	1996	Telephone/diary	2 000	2.5#	-
	2000	Telephone/diary	9 000	65	0.45
	2001	Telephone/diary	14 000	108	0.46
	2012	Panel survey	6 252	63	0.25

#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.

In response to the cost and scale challenges associated with onsite methods, in particular the difficulties in sampling other than trailer boat fisheries, offsite approaches to estimating recreational fisheries harvest have been revisited. This led to the development and implementation of a national panel survey for the 2011–12 fishing year. The panel survey used face-to-face interviews of a random sample of New Zealand households to recruit a panel of fishers and non-fishers for a full year. The panel members were contacted regularly about their fishing activities and catch information collected in standardised phone interviews. Note that the national panel survey estimate does not include recreational harvest taken under s111 general approvals on commercial vessels. The estimates of harvest from the panel survey were compared with direct estimates (using onsite surveys) for key stocks in FMA 1 (Edwards & Hartill 2015) and are considered reliable

1.3 Customary non-commercial fisheries

Kingfish is an important traditional food fish for Maori, but no quantitative information on the level of Maori customary non-commercial catch 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.

1.4 Illegal catch

There is no known illegal catch of kingfish.

1.5 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. Recreational fishers also release a large proportion of legal size kingfish.

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 been derived from opaque-zone counts in sagittal otolith thin sections. Estimates of kingfish von Bertalanffy growth parameters were also derived from recreational tagging data and otoliths collected from the eastern Bay of Plenty. Estimates of K and L_∞ 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 6). The hard-structure ageing techniques have yet to be validated for New Zealand kingfish, although the position of the first annulus has been validated using regular samples of 0+ year old fish from a fish aggregating device (Holdsworth et al 2013; Francis et al 2005).

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.

Estimates of M ranged 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 6.

Table 6: Estimates of biological parameters.

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

3. von Bertalanffy growth parameters

Females			Males			Combined			
L_∞	k	t_0	L_∞	k	t_0	L_∞	k	t_0	
Bay of Plenty (2002)									
135.79	0.119	-0.976	123.81	0.137	-0.911	130.14	0.128	-0.919	McKenzie et al (2014)
East Northland (2010)									
124.48	0.232	-0.890	113.69	0.279	-0.790				Holdsworth et al (2013)
Bay of Plenty (2010)									
125.63	0.211	-0.987	119.32	0.226	-0.976				Holdsworth et al (2013)

3. STOCKS AND AREAS

A study based on meristic characters and parasite loads 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 coast, 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 (Figure 2). 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

4.1 KIN 1 catch at age sampling

The age composition of the KIN 1 target recreational charter boat fleet catch was sampled in 2010–11 and in 2014–15 for the purpose of estimating total mortality (Z). Sampling was stratified into two regions East Northland and Bay of Plenty, and two strata based on distance from the shore: inshore on the North Island continental shelf (<200m) and around four offshore islands and pinnacles. Representative samples of kingfish over the MLS were obtained from the offshore Bay of Plenty and inshore east Northland with 831 and 863 kingfish measured over 75 cm in these two strata in 2014–15 (Table 7). Sampling was less successful in the inshore Bay of Plenty and the offshore east Northland but deemed usable by the NINSWG.

All kingfish were measured and recorded per trip on participating vessels. Age length keys were developed using otoliths from retained fish. Bay of Plenty offshore samples in 2010–11 included more old fish than those from inshore (Holdsworth et al 2013). The Bay of Plenty offshore age distribution in 2014–15 (Figure 3) was similar to that observed from the Bay of Plenty in 2010–11, although more older fish were evident in the 2014–15 sample. In 2014–15 there was a mode at age 5 in East Northland and age 6 in Bay of Plenty (Figure 3).

Table 7: Number of kingfish lengths and otolith sets collected in 2014–15 from the recreational fishery.

	KIN measured >75	Otoliths collected	Otoliths used in the age-length-key
Inshore Bay of Plenty	211	57	212
Offshore Bay of Plenty	831	156	
Inshore EN/HGU	863	217	271
Offshore East Northland	318	55	

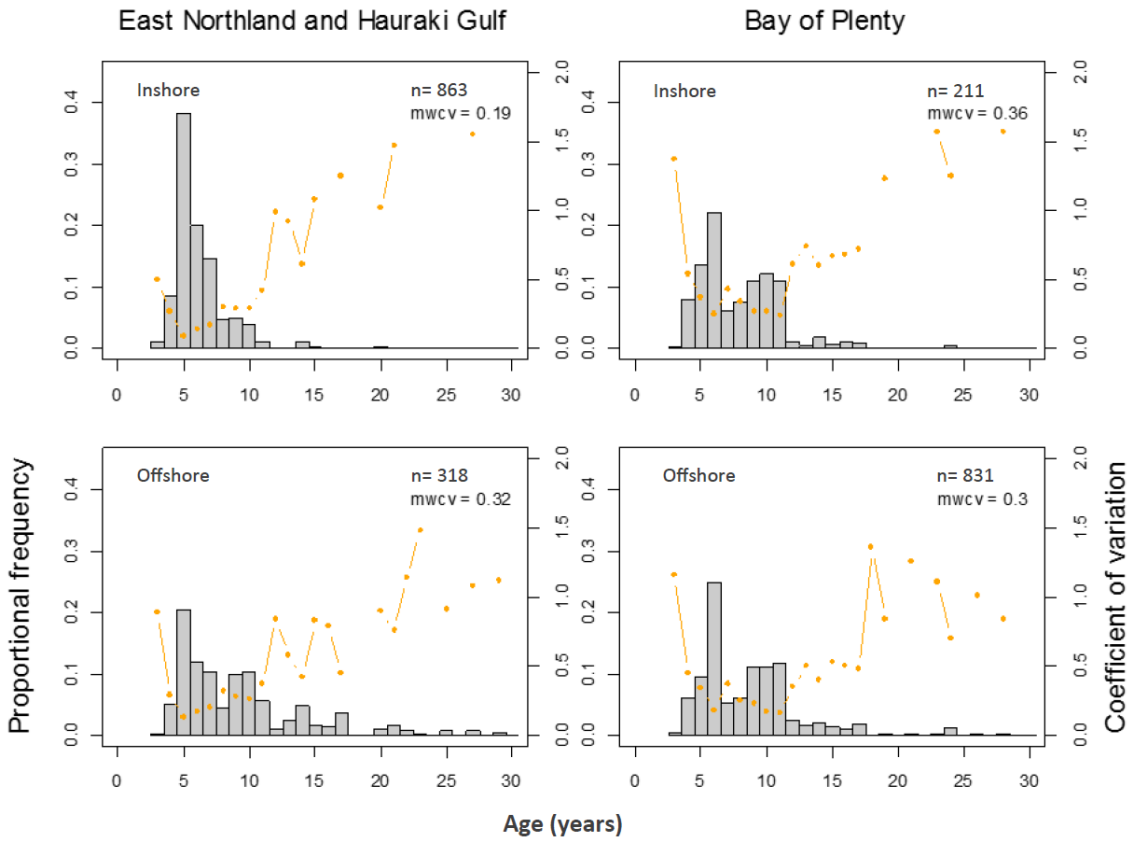


Figure 3: Kingfish age composition by region for inshore and offshore samples in 2014–15.

4.2 Estimates of fishery parameters and abundance

The Working Group agreed there was no valid method for combining inshore and offshore age frequencies by region for the purpose of estimating regional total mortality (Z), recommending instead that total mortality estimates be derived solely from the offshore age frequencies.

Total mortality estimates for offshore areas ranged from 0.19 to 0.25 for 2014–15 (Table 8). The $F_{SB40\%}$ target reference point for kingfish is 0.1, as derived by SSB/R methods (Holdsworth et al 2013). Assuming an instantaneous natural mortality rate (M) of 0.2; the target total mortality (Z) rate for kingfish is 0.3. None of the 2014–15 derived Z estimates given in Table 8 are higher than 0.3, suggesting that overfishing of kingfish in offshore areas of the Bay of Plenty and East Northland was unlikely. Although movement has been recorded between inshore and offshore areas, the relationship between these areas is unknown.

Table 8: Total mortality (Z) estimates for KIN 1 sub-regions as derived from catch-curve analysis (Chapman & Robson) of recreational charter-boat catch at-age data by fishing year, assuming 6 years is the age at full recruitment. The offshore estimate for the Bay of Plenty in 2009–10 was for the White Island area only and the offshore estimate for Northland in 2014–15 was for the Three Kings Area only. Bootstrap CVs are shown in parentheses.

	EN/HG		BoP	
Sub-Region	2009–10	2014–15	2009–10	2014–15
Inshore	0.87 (0.12)	0.49 (0.08)	0.50 (0.14)	0.29 (0.09)
Offshore	–	0.19 (0.08)	0.30 (0.14)	0.25 (0.07)

4.3 Biomass estimates

Few kingfish are encountered in trawl surveys because they are capable of swimming faster the nets, 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 are inadequate to estimate stock biomass because tag releases and recoveries are voluntary, not systematic.

4.4 Yield estimates and projections

No information is available.

4.5 Other factors

Kingfish in New Zealand can be regarded as a high value species from customary, commercial and recreational perspectives. Catch records from fishing clubs and amateur charter vessels show the number and size of kingfish has increased in recent years.

4.6 Future research needs

- Sensitivity analyses to determine the effect of progressively increasing the age of full recruitment on the estimates should be conducted.
- Selectivity appears to differ considerably by method (bait, jig) and area. A separate analysis should be undertaken for the bait fisheries only.
- Improved data to better understand inshore – offshore movements should be collected.
- CPUE based on charter boat catch and effort forms should be improved by reporting released kingfish less than the MLS separately from larger released kingfish.

5. STATUS OF THE STOCKS

Stock Structure Assumptions

The movement of New Zealand kingfish has been extensively investigated through mark-recapture programmes. Although some kingfish moved considerable distances (e.g. from New Zealand to Australia) most kingfish were recaptured close to the site of release, regardless of time at liberty. It is therefore assumed that New Zealand kingfish are comprised of several biological stocks. In addition to the results from tagging studies, the age structure of recreational catches suggests that kingfish off East Northland and in the Bay of Plenty in KIN 1 comprise separate stocks.

- **KIN 1 – Bay of Plenty**

Stock Status	
Year of Most Recent Assessment	2016
Assessment Runs Presented	Total mortality estimates from catch curve analysis for Inshore BPLE and Offshore BPLE

Reference Points	Target: $F_{SB40\%}$ (current estimate is $F_{SB40\%}$ = 0.1) Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: $F_{SB40\%}$
Status in relation to Target	Inshore BPLE: *F* is Likely (> 60%) to be at or below the target Offshore BPLE: *F* is Likely (> 60%) to be at or below the target
Status in relation to Limits	Soft Limit: Unknown for both Inshore BPLE and Offshore BPLE Hard Limit: Unknown for both Inshore BPLE and Offshore BPLE
Status in relation to Overfishing	Inshore BPLE: Overfishing is Unlikely (< 40%) to be occurring Offshore BPLE: Overfishing is Unlikely (< 40%) to be occurring

Historical Stock Status Trajectory and Current Status

-

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Unknown
Recent Trend in Fishing Intensity or Proxy	Since previous estimates were made in 2010, *F* appears to have declined for Inshore BPLE and Offshore BPLE (although White Island was the only BPLE area assessed in 2010); likely to have been low for the last decade in all BPLE areas
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-
Projections and Prognosis	
Stock Projections or Prognosis	Catch curve analysis from recent catch sampling (2014–15) indicates that total mortality is low for both the inshore and offshore regions, with fishing mortality below natural mortality and close to the target. Given the low TACC for KIN 1, inclusion on Schedule 6, increased MLS, and practice of catch and release by recreational anglers, stock size is unlikely to decline in the medium-term.
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown for both inshore and offshore areas Hard Limit: Unknown for both inshore and offshore areas
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unlikely (< 40%) for both inshore and offshore areas

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative stock assessment	
Assessment Method	Estimates of total mortality using Chapman-Robson estimator	
Assessment dates	Latest assessment: 2016	Next assessment: 2021
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	-Age structure of recreational catch in 2014–15 -Instantaneous rate of natural mortality (*M*) of 0.20 based on a maximum age of 23 years. - Age at 50% maturity (6 yr) -Age at MLS (4 yr) -Growth rate	 1 – High Quality 1 – High Quality 1 – High Quality 1 – High Quality 1 – High Quality
Data not used (rank)	N/A	

Changes to Model Structure and Assumptions	-
Major Sources of Uncertainty	- Uncertainty in the estimate of *M* - Uncertain relationship between inshore and offshore areas; available data do not support much movement of inshore fish to offshore areas

Qualifying Comments
The Z estimates are unweighted by relative catch by method (bait, jig) and area. The selectivity of the two capture methods differs substantially.
Fishery Interactions
Commercial kingfish catch is almost all bycatch in fisheries for other species.

- **KIN 1 – East Northland/Hauraki Gulf**

Stock Status	
Year of Most Recent Assessment	2016
Assessment Runs Presented	Total mortality estimates from catch curve analysis for Inshore ENHG and Offshore ENHG
Reference Points	Target: $F_{SB40\%}$ (current estimate is $F_{SB40\%}$ = 0.1) Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: $F_{SB40\%}$
Status in relation to Target	Inshore ENHG: *F* is Unlikely (< 40%) to be at or below the target Offshore ENHG: *F* is Likely (> 60%) to be at or below the target
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unknown
Status in relation to Overfishing	Inshore ENHG: Overfishing is Likely (> 60%) to be occurring Offshore ENHG: Overfishing is Unlikely (< 40%) to be occurring
Historical Stock Status Trajectory and Current Status -	

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	-
Recent Trend in Fishing Mortality or Proxy	Inshore ENHG: Unknown Offshore ENHG: Unknown; likely to have been low for the last decade
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-
Projections and Prognosis	
Stock Projections or Prognosis	Catch curve analysis from recent catch sampling (2014–15) indicates that total mortality is low for Offshore ENHG, with fishing mortality below natural mortality and close to the target. Given the low TACC for KIN 1, inclusion on Schedule 6, increased MLS, and practice of catch and release by recreational anglers, stock size for the offshore is unlikely to decline in the medium-term. For Inshore ENHG, fishing mortality is estimated to be above the target; the impact of this high *F* on future stock size is unknown.
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown for both inshore and offshore areas Hard Limit: Unknown for both inshore and offshore areas

Probability of Current Catch or TACC causing Overfishing to continue or commence	Inshore ENHG: Very Likely (> 90%) Offshore ENHG: Unlikely (< 40%)

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative stock assessment	
Assessment Method	Estimates of total mortality using Chapman-Robson estimator	
Assessment dates	Latest assessment: 2016	Next assessment: 2019
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	-Age structure of recreational catch in 2014–15 -Instantaneous rate of natural mortality (*M*) of 0.20 based on a maximum age of 23 years - Age at 50% maturity (6 yr) - Age at MLS (4 yr) - Growth rate	1 – High Quality 1 – High Quality 1 – High Quality 1 – High Quality 1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- Uncertainty in the estimate of *M* - Uncertain relationship between inshore and offshore areas; available data do not support much movement of inshore fish to offshore areas	

Qualifying Comments
The Z estimates are unweighted by relative catch by method (bait, jig) and area. The selectivity of the two capture methods differs substantially.
Fishery Interactions
Commercial kingfish catch is almost all bycatch in fisheries for other species.

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