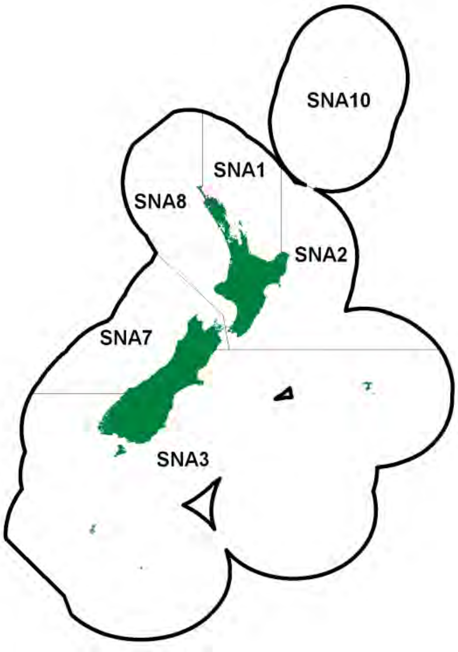
INTRODUCTION – SNAPPER (SNA)

(*Chrysophrys auratus*)
Tamure, Kouarea



1. INTRODUCTION

Specific Working Group reports, describing/including stock assessments, are given separately for SNA 1, SNA 2, SNA 7 and SNA 8. The TACC for SNA 3 and SNA 10 are 32 t and 10 t respectively, with minimal annual landings (less than 1 t or zero t in most years) reported from these stocks.

1.1 Commercial fisheries

Snapper fisheries are one of the largest and most valuable coastal fisheries in New Zealand. The commercial fisheries, which began their development in the late 1800s, expanded in the 1970s with increased catches by trawl and Danish seine. Following the introduction of pair trawling in most areas, landings peaked in 1978 at 17 500 t (Table 1). Pair trawling was the dominant method, accounting for on average 75% of the annual SNA 8 catch from 1976 to 1989. In the 1980s an increasing proportion of the SNA 1 catch was taken by longlining as the Japanese "iki jime" market was developed. By the mid-1980s catches had declined to 8500–9000 t, and some stocks showed signs of overfishing. The fisheries had become more dependent on the recruiting year classes as stock size decreased. With the introduction of the QMS in 1986, TACCs in all Fishstocks were set at levels intended to allow for some stock rebuilding. Decisions by the Quota Appeal Authority saw TACCs increase to over 6000 t for SNA 1 by the fishing year 1990–91, and from 1330 t to 1594 t for SNA 8 by 1989–90 (Table 2).

In 1986–87, landings from the two largest Fishstocks (i.e., SNA 1 and SNA 8) were less than their respective TACCs (Table 2) but catches subsequently increased in 1987–88 to the level of the TACCs (Figure 1). Landings from SNA 7 remained below the TACC after introduction to the QMS, and in 1989–90 the TACC was reduced to 160 t. Changes to TACCs that took effect from 1 October 1992 resulted in a reduction for SNA 1 from 6010 t to 4938 t, an increase for SNA 2 from 157 t to 252 t, and a reduction for SNA 8 from 1594 t to 1500 t.

Table 1: Reported landings (t) for the main QMAs from 1931 to 1990.

Year	SNA 1	SNA 2	SNA 7	SNA 8	Year	SNA 1	SNA 2	SNA 7	SNA 8
1931–32	3 355	0	69	140	1961	5 887	589	583	1 178
1932–33	3 415	0	36	159	1962	6 502	604	582	1 352
1933–34	3 909	21	65	213	1963	6 967	636	569	1 456
1934–35	4 317	168	7	190	1964	7 269	667	574	1 276
1935–36	5 387	149	10	108	1965	7 991	605	780	1 182
1936–37	6 369	78	194	103	1966	8 762	744	1 356	1 831
1937–38	5 665	114	188	85	1967	9 244	856	1 613	1 477
1938–39	6 145	122	149	89	1968	10 328	765	1 037	1 491
1939–40	5 918	100	158	71	1969	11 318	837	549	1 344
1940–41	5 100	103	174	76	1970	12 127	804	626	1 588
1941–42	4 791	148	128	62	1971	12 709	861	640	1 852
1942–43	4 096	74	65	57	1972	11 291	878	767	1 961
1943–44	4 456	60	29	75	1973	10 450	798	1 258	3 038
1944	4 909	49	96	69	1974	8 769	716	1 026	4 340
1945	4 786	59	118	124	1975	6 774	732	789	4 217
1946	5 150	77	232	244	1976	7 743	732	1 040	5 326
1947	5 561	36	475	251	1977	7 674	374	714	3 941
1948	6 469	53	544	215	1978	9 926	454	2 720	4 340
1949	5 655	215	477	277	1979	10 273	662	1 776	3 464
1950	4 945	285	514	318	1980	7 274	636	732	3 309
1951	4 173	265	574	364	1981	7 714	283	592	3 153
1952	3 665	220	563	361	1982	7 089	160	591	2 636
1953	3 581	247	474	1 124	1983	6 539	160	544	1 814
1954	4 180	293	391	1 093	1984	6 898	227	340	1 536
1955	4 323	309	504	1 202	1985	5 876	208	270	1 866
1956	4 615	365	822	1 163	1986	5 969	255	253	959
1957	5 129	452	1 055	1 472	1987	4 016	122	210	1 072
1958	5 007	483	721	1 128	1988	5 038	165	193	1 565
1959	5 607	372	650	1 114	1989	5 754	227	292	1 571
1960	5 889	487	573	1 202	1990	5 826	429	200	1 551

Notes:

1. The 1931–1943 years are April–March but from 1944 onwards are calendar years.
2. The 'QMA totals' are approximations derived from port landing subtotals, as follows: SNA 1, Mangonui to Whakatane; SNA 2 Gisborne to Wellington/Makara; SNA 7, Marlborough Sounds ports to Greymouth; SNA 8 Paraparaumu to Hokianga.
3. Before 1946 the 'QMA' subtotals sum to less than the New Zealand total because data from the complete set of ports are not available. Subsequent minor differences result from small landings in SNA 3, not listed here.
4. Data up to 1985 are from fishing returns: data from 1986 to 1990 are from Quota Management Reports.
5. Data for the period 1931 to 1982 are based on reported landings by harbour and are likely to be underestimated as a result of under-reporting and discarding practices. Data include both foreign and domestic landings.

Table 2: Reported landings (t) of snapper by Fishstock from 1983–84 to present and gazetted and actual TACCs (t) for 1986–87 to present. QMS data from 1986–present. [Continued on next page]

Fishstock	SNA 1		SNA 2		SNA 3		SNA 7		SNA 8	
FMAs	1		2		3, 4, 5, 6		7		8, 9	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1983–84†	6 539	–	145	–	2	–	375	–	1 725	–
1984–85†	6 898	–	163	–	2	–	255	–	1 546	–
1985–86†	5 876	–	177	–	0	–	188	–	1 828	–
1986–87	4 016	4 710	130	130	< 1	32	257	330	893	1 331
1987–88	5 038	5 098	152	137	1	32	256	363	1 401	1 383
1988–89	5 754	5 614	210	157	< 1	32	176	372	1 527	1 508
1989–90	5 826	5 981	364	157	< 1	32	294	151	1 551	1 594
1990–91	5 273	6 002	428	157	< 1	32	160	160	1 659	1 594
1991–92	6 176	6 010	373	157	< 1	32	148	160	1 459	1 594
1992–93	5 427	4 938	324	252	< 1	32	165	160	1 543	1 500
1993–94	4 847	4 938	307	252	< 1	32	147	160	1 542	1 500
1994–95	4 857	4 938	308	252	< 1	32	150	160	1 436	1 500
1995–96	4 938	4 938	280	252	< 1	32	146	160	1 558	1 500
1996–97	5 047	4 938	351	252	< 1	32	162	160	1 613	1 500
1997–98	4 525	4 500	286	252	< 1	32	182	200	1 589	1 500
1998–99	4 412	4 500	283	252	2	32	142	200	1 636	1 500
1999–00	4 509	4 500	390	252	< 1	32	174	200	1 604	1 500
2000–01	4 347	4 500	360	252	< 1	32	156	200	1 631	1 500
2001–02	4 374	4 500	252	252	1	32	141	200	1 577	1 500
2002–03	4 487	4 500	334	315	< 1	32	187	200	1 558	1 500
2003–04	4 469	4 500	339	315	< 1	32	215	200	1 667	1 500
2004–05	4 641	4 500	399	315	< 1	32	178	200	1 663	1 500
2005–06	4 539	4 500	389	315	< 1	32	166	200	1 434	1 300
2006–07	4 429	4 500	329	315	< 1	32	248	200	1 327	1 300
2007–08	4 548	4 500	328	315	< 1	32	187	200	1 304	1 300
2008–09	4 543	4 500	307	315	< 1	32	205	200	1 345	1 300
2009–10	4 465	4 500	296	315	< 1	32	188	200	1 280	1 300
2010–11	4 516	4 500	320	315	< 1	32	206	200	1 313	1 300
2011–12	4 614	4 500	358	315	< 1	32	216	200	1 360	1 300

Table 2 [Continued]:

Fishstock	SNA 1		SNA 2		SNA 3		SNA 7		SNA 8	
FMAs	1		2		3, 4, 5, 6		7		8, 9	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
2012–13	4 457	4 500	310	315	< 1	32	211	200	1 331	1 300
2013–14	4 459	4 500	313	315	< 1	32	210	200	1 275	1 300
2014–15	4 479	4 500	271	315	< 1	32	210	200	1 272	1 300
2015–16	4 408	4 500	321	315	< 1	32	189	200	1 328	1 300
2016–17	4 620	4 500	373	315	< 1	32	263	250	1 334	1 300
2017–18	4 567	4 500	373	315	< 1	32	263	250	1 288	1 300
2018–19	4 437	4 500	364	315	< 1	32	257	250	1 293	1 300
2019–20	4 460	4 500	330	315	< 1	32	289	250	1 347	1 300
2020–21	4 579	4 500	321	315	< 1	32	337	350	1 295	1 300
2021–22	4 296	4 500	337	315	< 1	32	361	350	1 720	1 600
2022–23	4 474	4 500	339	315	< 1	32	518	450	1 728	1 600

Fishstock	SNA 10			
QMAs	10		Total	
	Landings	TACC	Landings§	TACC
1983–84†	0	–	9 153	–
1984–85†	0	–	9 228	–
1985–86†	0	–	8 653	–
1986–87	0	10	5 314	6 540
1987–88	0	10	6 900	7 021
1988–89	0	10	7 706	7 691
1989–90	0	10	8 034	7 932
1990–91	0	10	7 570	7 944
1991–92	0	10	8 176	7 962
1992–93	0	10	7 448	6 858
1993–94	0	10	6 842	6 883
1994–95	0	10	6 723	6 893
1995–96	0	10	6 924	6 893
1996–97	0	10	7 176	6 893
1997–98	0	10	6 583	6 494
1998–99	0	10	6 475	6 494
1999–00	0	10	6 669	6 494
2000–01	0	10	6 496	6 494
2001–02	0	10	6 342	6 494
2002–03	0	10	6 563	6 557
2003–04	0	10	6 686	6 557
2004–05	0	10	6 881	6 557
2005–06	0	10	6 527	6 357
2006–07	0	10	6 328	6 357
2007–08	0	10	6 367	6 357
2008–09	0	10	6 399	6 357
2009–10	0	10	6 230	6 357
2010–11	0	10	6 355	6 357
2011–12	0	10	6 547	6 357
2012–13	0	10	6 309	6 357
2013–14	0	10	6 256	6 357
2014–15	0	10	6 232	6 357
2015–16	0	10	6 247	6 357
2016–17	0	10	6 590	6 407
2017–18	0	10	6 490	6 407
2018–19	0	10	6 351	6 407
2019–20	0	10	6 425	6 407
2020–21	0	10	6 532	6 507
2021–22	0	10	6 714	6 807
2022–23	0	10	7 059	6 907

† FSU data. SNA 1 = Statistical Areas 001–010; SNA 2 = Statistical Areas 011–016; SNA 3 = Statistical Areas 018–032; SNA 7 = Statistical Areas 017, 033–036, 038; SNA 8 = Statistical Areas 037, 039–048.

From 1 October 1997 the TACC for SNA 1 was reduced to 4500 t, within an overall TAC of 7550 t, and the TACC for SNA 7 was increased to 200 t within an overall TAC of 306 t. In SNA 2, the bycatch of snapper in the tarakihi, red gurnard, and other fisheries resulted in overruns of the snapper TACC in all years from 1987–88 up to 2000–01. From 1 October 2002, the TACC for SNA 2 was increased from 252 t to 315 t, within a total TAC of 450 t. Nevertheless the 315 t TACC has regularly been over-caught since, except in the fishing years 2008–09 to 2009–10 and 2012–13 to 2014–15. In 2016–17, the TAC for SNA 7 was increased from 306 t to 545 t, including an increase in the TACC from 200 t to 250 t. The SNA 7 TACC was increased again in 2020–21 to 350 t. From 1 October 2005 the TACC for SNA 8 was reduced to 1300 t within a TAC of 1785 t, and later increased from 2021 to 1600 t within a TAC of 3065 t following a rebuild of the stock. Table 3 shows the TACs, TACCs, and allowances for each

Fishstock from 1 October 2020. All commercial fisheries have a minimum legal size (MLS) for snapper of 25 cm.

Table 3: TACs, TACCs, and allowances (t) for snapper by Fishstock from 1 October 2020.

Fishstock	TAC	TACC	Customary allowance	Recreational allowance	Other mortality
SNA 1	8 050	4 500	50	3 050	450
SNA 2	450	315	14	90	31
SNA 3		32	–	–	–
SNA 7	645	350	20	250	25
SNA 8	3 065	1 600	100	1 205	160
SNA 10		10	–	–	–

Foreign fishing

Japanese catch records and observations made by New Zealand naval vessels indicate that significant quantities of snapper were taken from New Zealand waters by Japanese vessels from the late 1950s until 1977. There are insufficient data to quantify historical Japanese catch tonnages for the respective snapper stocks. However, trawl catches have been reported by area from 1967 to 1977, and longline catches from 1975 to 1977 (Table 4). These data were supplied to the Fisheries Research Division of MAF in the late 1970s; however, the data series is incomplete, particularly for longline catches.

Table 4: Reported landings (t) of snapper from 1967 to 1977 by Japanese trawl and longline fisheries. These landings are included in Table 1.

Year	(a) Trawl	Trawl catch (all species)	Total snapper trawl catch	SNA 1	SNA 7	SNA 8
1967		3092	30	NA	NA	NA
1968		19 721	562	1	17	309
1969		25 997	1 289	–	251	929
1970		31 789	676	2	131	543
1971		42 212	522	5	115	403
1972		49 133	1 444	1	225	1 217
1973		45 601	616	–	117	466
1974		52 275	472	–	98	363
1975		55 288	922	26	85	735
1976		133 400	970	NA	NA	676
1977		214 900	856	NA	NA	708
Year	**(b) Longline**		**Total Snapper**	**SNA 1**	**SNA 7**	**SNA 8**
1975			1 510	761	–	749
1976			2 057	930	–	1 127
1977			2 208	1 104	–	1 104

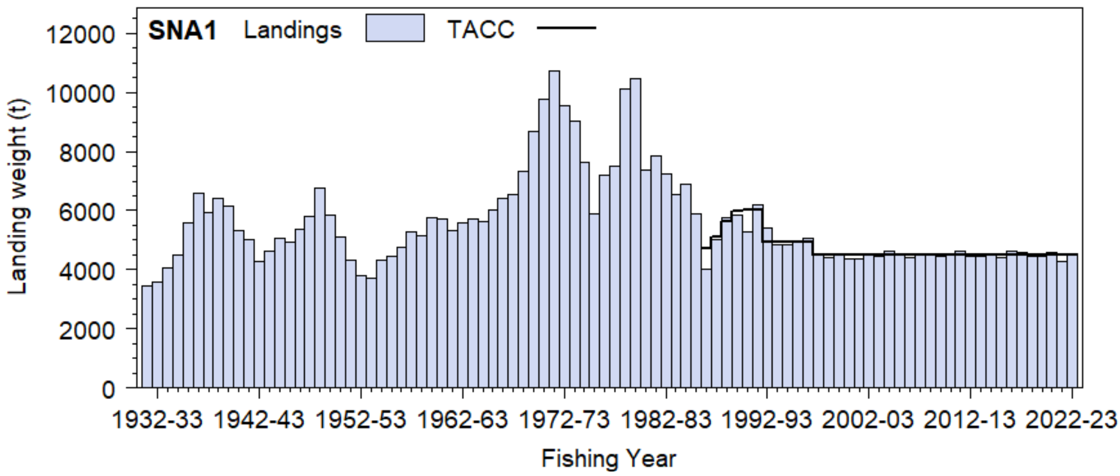


Figure 1: Total reported landings and TACCs for the four main SNA stocks. SNA 1 (Central East). [Continued on next page]

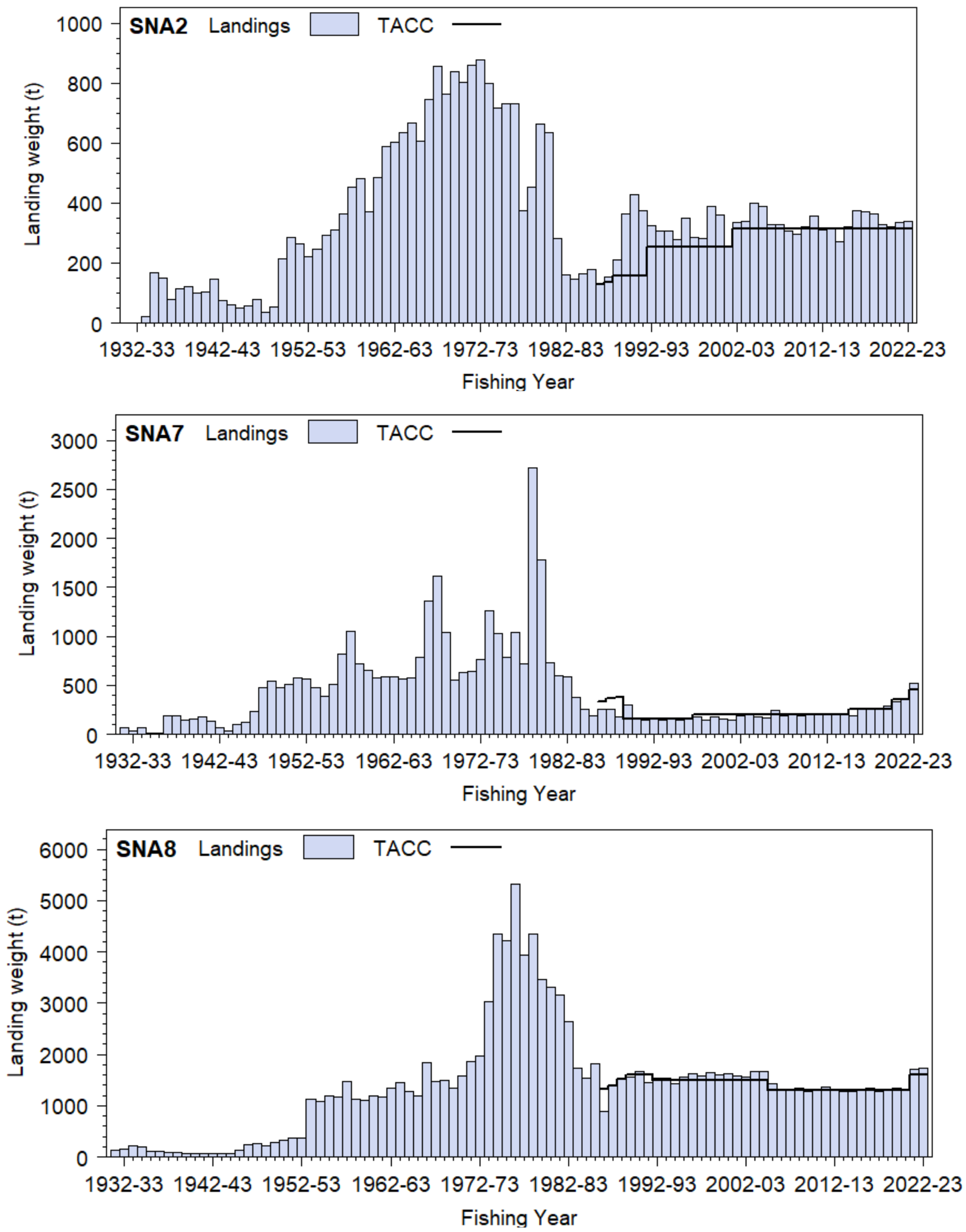


Figure 1 [Continued]: Total reported landings and TACC for the four main SNA stocks. SNA 2 (Central East) and SNA 7 (Challenger) and SNA 8 (Central Egmont).

1.2 Recreational fisheries

The snapper fishery is the largest recreational fishery in New Zealand. It is the major target species on the northeast and northwest coasts of the North Island and is targeted seasonally around the rest of the North Island and the top of the South Island. The current allowances within the TAC for each Fishstock are shown in Table 3.

1.2.1 Management controls

The two main methods used to manage recreational harvests of snapper are minimum legal size limits (MLS) and daily bag limits. Both have changed over time (Table 5). The number of hooks permitted on a recreational longline was reduced from 50 to 25 in 1995.

Table 5: Changes to minimum legal size limits (MLS) and daily bag limits used to manage recreational harvesting levels in snapper stocks, 1985–2014.

Stock	MLS	Bag limit	Introduced
SNA 1	25	30	1/01/1985
SNA 1	25	20	30/09/1993
SNA 1	27	15	1/10/1994
SNA 1	27	9	13/10/1995
SNA 1	30	7	1/04/2014
SNA 2	25	30	1/01/1985
SNA 2	27	10	1/10/2005
SNA 3	25	30	1/01/1985
SNA 3	25	10	1/10/2005
SNA 7	25	30	1/01/1985
SNA 7 (excl Marlborough Sounds)	25	10	1/10/2005
SNA 7 (Marlborough Sounds)	25	3	1/10/2005
SNA 8	25	30	1/01/1985
SNA 8 (FMA 9 only)	25	20	30/09/1993
SNA 8 (FMA 9 only)	27	15	1/10/1994
SNA 8	27	10	1/10/2005

1.2.2 Estimates of recreational harvest

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 were calculated using an onsite approach, a tag ratio method for SNA 1, in the mid-1980s (Table 6). A tonnes per tag ratio was obtained from commercial tag return data and this tonnage was multiplied by the number of tags returned by recreational fishers to estimate recreational harvest tonnages. The tag ratio method requires that all tagged fish caught by recreational fishers are recorded, or at least that the under-reporting rate of recreational fishers is the same as that of commercial fishers. This was assumed, although no data were available to test the assumption. If the recreational under-reporting rate was greater than that of the commercial fishers a negative bias would result. In SNA 8 there was evidence that many tags recovered by commercial fishing were reported as recreational catch during the 1991 tag recapture phase, which would give a positive bias to estimates.

The next method used to generate recreational harvest estimates was the offsite regional telephone and diary survey approach: MAF Fisheries South (1991–92), Central (1992–93), and North (1993–94) regions (Teirney et al 1997). 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 2002) and a rolling replacement of diarists in 2001 (Boyd et al 2004) allowed estimates for a further year (population scaling ratios and mean weights were not re-estimated in 2001). Other than for the 1991–92 MAF Fisheries South survey, the diary method used mean weights of snapper obtained from fish measured at boat ramps.

The harvest estimates provided by the 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 including snapper, 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 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 in the Hauraki Gulf in 2003–04 and was then extended to survey the wider SNA 1 fishery in 2004–05 and was used in 2011–12 and 2017–18 to corroborate concurrent national panel surveys. This approach has also been used to estimate recreational harvests from SNA 7 (2005–06 and 2015–16 fishing years) and SNA 8 (2006–07). The Marine Amateur Fisheries and Snapper Working Groups both concluded that this approach generally provided reliable estimates of recreational harvest for these fish stocks.

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 implementation of a national panel survey during the 2011–12 fishing year (Wynne-Jones et al 2014). The panel survey used face-to-face interviews of a random sample of 30 390 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 was collected in computer-assisted standardised phone interviews. The national panel survey was repeated during the 2017–18 and 2022–23 fishing years using very similar methods to produce directly comparable results (Wynne-Jones et al 2019; Heinemann & Gray, in prep). Recreational catch estimates from the three national panel surveys are given in Table 6. Note that national panel survey estimates do not include recreational harvest taken on charter vessel trips or under s111 general approvals.

Monitoring harvest

In addition to estimating absolute harvests, a system to provide relative estimates of harvest over time for key fishstocks has been designed and implemented for some key recreational fisheries. The system uses web cameras to continuously monitor trends in trailer boat traffic at key boat ramps. This monitoring is complemented by creel surveys that provide estimates of the proportion of observed boats that were used for fishing, and of the average harvest of snapper and kahawai per boat trip. These data are combined to provide relative harvest estimates for SNA 1.

Trends inferred from this monitoring programme were initially very similar to that inferred from aerial-access harvest estimates in the Hauraki Gulf in 2004–05, 2006–07, and 2011–12, but the camera/creel snapper harvest estimate for the Hauraki Gulf in 2017–18 is substantially lower than concurrent aerial-access and national panel surveys estimates for the same year (Table 6a cf. Table 6). This difference appears to be due to a recent substantial increase in recreational fishing effort and catch around expanding mussel farms in the Firth of Thames, coinciding with a lesser increase in effort in the north-western Hauraki Gulf. Additional creel survey monitoring has been initiated to monitor changes in the recreational fishery in these areas, which had not been adequately monitored from boat ramps in the Auckland metropolitan area up until 2019–20. These estimates show that the recreational snapper harvest varies substantially more than would be expected if catches were related only to stock abundance; this suggests that changes in localised availability to recreational fishers can also have a marked effect on the recreational harvest. Web camera monitoring is continuing, and the coverage is being progressively extended to other FMAs.

1.2.2.1 SNA 1

Aerial-access surveys were conducted in FMA 1 in 2011–12 and 2017–18 (Hartill et al 2013, 2019) to independently provide harvest estimates for comparison with those generated from concurrent national panel surveys (excluding the Chatham Islands). Both surveys appear to have provided plausible results that corroborate each other and are therefore considered to be broadly reliable. Harvest estimates provided by these surveys are given in Table 6. Regional harvest estimates provided by the 2004–05 and 2011–12 aerial-access surveys were used to inform the 2013 stock assessment for SNA 1. Web camera/creel survey monitoring (see Table 6a) suggests that the recreational harvest of snapper in SNA 1 can vary greatly between years. The overall trend across all three regions of SNA 1 suggests a decline in the recreational harvest in the years following 2011–12, that was mostly driven by declining catch rates in the Hauraki Gulf. This was followed by a period of increasing recreational harvest in recent years, from 2015–16.

Table 6: Recreational catch estimates for snapper stocks. Totals for a stock are given in bold. The telephone/diary surveys ran from December to November but are denoted by the January calendar year. Mean fish weights were obtained from boat ramp surveys (for the telephone/diary and panel survey catch estimates). Numbers and mean weights are not calculated in the tag ratio method. Includes charter boat catch and panel survey estimates of s111 catches. [Continued on next page]

Stock	Year	Method	Number of fish (thousands)	Mean weight (g)	Total weight (t)	CV
SNA 1						
East Northland	1985	Tag ratio	–	–	370	–
Hauraki Gulf	1985	Tag ratio	–	–	830	–
Bay of Plenty	1984	Tag ratio	–	–	400	–
Total	1985[1]	Tag ratio	–	–	**1 600**	–
Total	1994	Telephone/diary	3 804	871	**2 857**	–
East Northland	1996	Telephone/diary	684	1 039	711	–
Hauraki Gulf/BoP	1996	Telephone/diary	1 852	870	1 611	–
Total	1996	Telephone/diary	2 540	915	**2 324**	–
East Northland	2000	Telephone/diary	1 457	1 154	1 681	–
Hauraki Gulf	2000	Telephone/diary	3 173	830	2 632	–
Bay of Plenty	2000	Telephone/diary	2 274	872	1 984	–
Total	2000	Telephone/diary	6 904	904	**6 242**	–
East Northland	2001	Telephone/diary	1 446	–[5]	1 669	–
Hauraki Gulf	2001	Telephone/diary	4 225	–[5]	3 507	–
Bay of Plenty	2001	Telephone/diary	1 791	–[5]	1 562	–
Total	2001	Telephone/diary	7 462	–[5]	**6 738**	–
Hauraki Gulf	2003–04	Aerial-access	–	–	1 334	0.09
East Northland	2004–05	Aerial-access	–	–	557	0.13
Hauraki Gulf	2004–05	Aerial-access	–	–	1 345	0.10
Bay of Plenty	2004–05	Aerial-access	–	–	516	0.10
Total	2004–05	Aerial-access	–	–	**2 419**	**0.06**
East Northland	2011–12	Aerial-access	–	–	718	0.14
Hauraki Gulf	2011–12	Aerial-access	–	–	2490	0.08
Bay of Plenty	2011–12	Aerial-access	–	–	546	0.12
Total	2011–12	Aerial-access	–	–	**3 754**	**0.06**
East Northland	2011–12	Panel survey	686	1 266	869	0.13
Hauraki Gulf	2011–12	Panel survey	2 216	1 022 / 987[6]	2 254	0.12
Bay of Plenty	2011–12	Panel survey	691	956 /1 003[6]	669	0.12
Total	2011–12	Panel survey	3 594	1 025	**3 792**	**0.08**
East Northland	2017–18	Aerial-access	–	–	720	0.10
Hauraki Gulf	2017–18	Aerial-access	–	–	2 068	0.07
Bay of Plenty	2017–18	Aerial-access	–	–	680	0.10
Total	2017–18	Aerial-access	–	–	**3 467**	**0.05**
East Northland	2017–18	Panel survey	563	1 351	761	0.12
Hauraki Gulf	2017–18	Panel survey	1 352	1 162/1 189	1 578	0.11
Bay of Plenty	2017–18	Panel survey	552	1 116/1 205	628	0.12
Total	2017–18	Panel survey	2 467	1 202	**2 967**	**0.07**
East Northland	2022–23	Panel survey	317	1 308	415	0.11
Hauraki Gulf	2022–23	Panel survey	608	1 044/997	629	0.09
Bay of Plenty	2022–23	Panel survey	378	1 243	470	0.13
Total	2022–23	Panel survey	130		**1 514**	**0.60**

1.2.2.2 SNA 2

National Panel Survey harvest estimates are available for SNA 2 from 2011–12 and 2017-18. Web camera/creel survey monitoring has been undertaken within SNA 2 since 2014–15 (monitoring at Napier and Gisborne). These data show a generally increasing trend in snapper harvest, but since the series only overlaps with one National Panel Survey (2017–18), scaled estimates of annual harvest (Table 6b) from the relative boat ramp harvest index should be considered preliminary (B. Hartill, pers. comm.).

Table 6 [Continued]: Recreational catch estimates for snapper stocks. Totals for a stock are given in bold. The telephone/diary surveys ran from December to November but are denoted by the January calendar year. Mean fish weights were obtained from boat ramp surveys (for the telephone/diary and panel survey catch estimates). Numbers and mean weights are not calculated in the tag ratio method. Includes charter boat catch and panel survey estimates of s111 catches.

Stock	Year	Method	Number of fish (thousands)	Mean weight (g)	Total weight (t)	CV
SNA 2						
Total	1993	Telephone/diary	28	1 282	**36**	–
Total	1996	Telephone/diary	31	1 282[2]	**40**	–
Total	2000	Telephone/diary	268	1 200[4]	**322**	–
Total	2001	Telephone/diary	144	–[5]	**173**	–
Total	2011–12	Panel survey	55	1 027	**57**	**0.25**
Total	2017–18	Panel survey	82	1 117	**91**	**0.24**
Total	2022–23	Panel survey	88	1 282/1 610	**116**	**0.25**
SNA 7						
Tasman Bay /Golden Bay	1987	Tag ratio	–	–	**15**	–
Total	1993	Telephone/diary	77	2 398[3]	**184**	–
Total	1996	Telephone/diary	74	2 398	**177**	–
Total	2000	Telephone/diary	63	2 148	**134**	–
Total	2001	Telephone/diary	58	–[5]	**125**	–
Total	2005–06	Aerial-access	–	–	**43**	**0.17**
Total	2011–12	Panel survey	110	799	**88**	**0.17**
Total	2015–16	Aerial-access	–	–	**83**	**0.18**
Total	2017–18	Panel survey	95	1 505	**144**	**0.16**
Total	2022–23	Panel survey	88	1 446/1 836	**130**	**0.14**
SNA 8						
Total	1991	Tag ratio	–	–	**250**	–
Total	1994	Telephone/diary	361	658	**238**	–
Total	1996	Telephone/diary	271	871	**236**	–
Total	2000	Telephone/diary	648	1 020	**661**	–
Total	2001	Telephone/diary	1 111	–	**1 133**	–
Total	2007	Aerial-access	–	–	**260**	**0.10**
Total	2011–12	Panel survey	557	770 /1 255 / 1 160[7]	**630**	**0.16**
Total	2017–18	Panel survey	654	–	**830**	**0.13**
Total	2022–23	Panel survey	355	1 500/1 359	**543**	**0.12**

[1] The Bay of Plenty programme was carried out in 1984 but is included in the 1985 total estimate.
[2] Mean weight obtained from 1992–93 boat ramp sampling.
[3] Mean weight obtained from 1995–96 boat ramp sampling.
[4] Mean weight obtained from 1999–2000 commercial landed catch sampling.
[5] The 2000 mean weights were used in the 2001 estimates.
[6] Separate mean weight estimates were used for summer (1 October 2011 to 30 April 2012) and for winter (1 May to 30 September 2012).
[7] Separate mean weight estimates were used for harbours (Kaipara and Manukau)/North coast (open coast fishery north of Tirua Point)/ South coast (open coast fishery south of Tirua Point).

Table 6a: Recreational catch estimates (t) for snapper in different parts of the SNA 1 stock area calculated from web camera and creel monitoring at key ramps combined with aerial-access estimates for each area in 2004–05 and 2006–07 (Hauraki Gulf only) and 2011–12 and 2018–19 (all areas within SNA 1).

Year	East Northland	CV	Hauraki Gulf	CV	Bay of Plenty	CV	Total SNA 1	CV
2004–05	730	0.14	1 216	0.13	605	0.15	2 551	0.08
2006–07	–	–	1 224	0.16	–	–	–	–
2011–12	689	0.13	2 772	0.09	596	0.18	4 057	0.07
2012–13	679	0.15	1 718	0.09	273	0.21	2 671	0.07
2013–14	540	0.12	876	0.13	216	0.19	1 632	0.08
2014–15	511	0.14	735	0.11	223	0.25	1 469	0.08
2015–16	647	0.13	657	0.15	171	0.19	1 475	0.09
2016–17	649	0.13	649	0.12	385	0.19	1 683	0.08
2017–18	751	0.13	1 037	0.11	623	0.16	2 410	0.08
2018–19	1 030	0.09	1 312	0.09	376	0.13	2 718	0.06

1.2.2.3 SNA 7

Plausible estimates for recreational catches from SNA 7 are available from the 1987 tagging programme, the aerial access surveys (in 2005–06 and 2015–16) and the national panel surveys (2011–12 and 2017–18). The estimates of recreational catch increased considerably from 2005–06 to 2017–18.

Table 6b: Preliminary recreational catch estimates for SNA 2, split by SNA 2N and SNA 2S, on basis of National Panel Survey and web camera/creel survey monitoring.

Year	SNA 2N	SNA 2S	SNA 2	source
2011–12	29.5	26.3	55.8	NPS
2012–13				
2013–14				
2014–15	10.9	25.8	36.7	Scaled creel survey
2015–16	18.4	33.6	52.0	Scaled creel survey
2016–17	13.9	36.5	50.4	Scaled creel survey
2017–18	35.2	57.9	93.1	NPS
2018–19	41.8	87.8	129.7	Scaled creel survey
2019–20	34.6	43.8	78.4	Scaled creel survey
2020–21	53.1	60.5	113.6	Scaled creel survey

Most of the recreational catch has been recorded from Tasman Bay and Golden Bay. The catch is predominantly taken by rod-and-line, although a significant proportion of the catch was taken by longline during the mid 2010s. A small proportion of the total SNA 7 recreational catch was recorded from the Marlborough Sounds.

1.2.2.4 SNA 8

In 2005, the Snapper Working Group and Plenary considered recreational catches from SNA 8. Two alternative levels were assumed for the recreational catch from 1990 to 2004, either 300 t or 600 t. The Plenary considered these values were likely to bracket the true average level of catch in this period. The estimate from the 2006–07 aerial overflight survey of the SNA 8 fishery (260 t) suggests that the assumed value of 300 t may have been the more plausible. There are potential sources of bias associated with the aerial-access estimate, both negative (a potential underestimation of the shore-based harvest, especially to the south) and positive (over-reporting of harvests by charter boat operators in a log book survey which are included in the estimate). The 2011–12 and 2017–18 national panel surveys provided plausible results and are considered to be broadly reliable and suggest that catch is increasing. Web camera/ creel survey monitoring in SNA 8 started in late 2011 and has found no general trend in fishing effort, but a gradual fluctuating increase in catch rates and hence harvest, since that time. No estimates of absolute catch have yet been developed from these data.

1.3 Customary non-commercial fisheries

Snapper form important fisheries for customary non-commercial, but the annual catch is not known. The information on Māori customary harvest under the provisions made for customary fishing is limited (Table 6c). It is likely that Māori customary fishers utilise the provisions under recreational fishing regulations. Customary reporting varies within SNA 8. Large areas of SNA 8 are gazetted under the

Fisheries (Kaimoana Customary Fishing) Regulations 1998 which require reporting on authorisations. In the areas not gazetted, customary fishing authorisations issued would be under the Fisheries (Amateur Fishing) Regulations 2013, where there is no requirement to report. The numbers reported in Table 6b may be underestimated.

Table 6c: Customary approvals and reported harvest in SNA 8 from 2005–06 to present.

Year	Quantity approved (kg)	Reported actual quantity harvested (kg)	Number of authorisations issued
2005–06	250		4
2006–07	120	40	2
2007–08	130	30	2
2008–09	330	151	5
2009–10	4 747	3 046	14
2010–11	5 130	3 089	14
2011–12	3 800	2 633	16
2012–13	4 367	2 439	17
2013–14	12 825	4 514	30
2014–15	17 730	5 887	20
2015–16	14 388	6 553	31
2016–17	3 693	1 669	17
2017–18	770	534	11
2018–19	7 090	1 344	32
2019–20	15 500	2 422	34
2020–21	9 770	270	24
2021–22	2 460		7
2022–23	29 225		74

There are no estimates of customary catch available for SNA 7. Current levels of customary catch in SNA 7 are considered to be small and are assumed to be included into recreational catch estimates.

1.4 Illegal catch

No new analyses are available that provide estimates of illegal catch. For modelling SNA 1, SNA 7, and SNA 8, an assumption was made that non-reporting of catch was 20% of reported domestic commercial catch prior to 1986 and 10% of reported domestic commercial catch since the QMS was introduced. This was to account for all forms of under-reporting. These proportions were estimated in 1996, taking account of information on the black-market trade in snapper and higher levels of under-reporting (to avoid tax) that existed prior to the introduction of the QMS. The 10% under-reporting post-QMS accounts for the practice of under-recording of landed weights and the discarding of legal-size snapper. From 2016–2018 all snapper 1 trawl vessels participated in a video observation programme (Middleton & Guard 2021); the focus of that project was verification of the quantity of undersized fish returned to the sea, but significant discarding of legal-sized snapper by these vessels was unlikely during this period.

1.5 Other sources of mortality

No estimates are available regarding the amount of other sources of mortality on snapper stocks; although high-grading of longline fish and discarding of under-sized fish by all methods occurs. An at-sea study of SNA 1 commercial longline fisheries in 1997 (McKenzie 2000) found that 6–10% of snapper caught by number were under 25 cm (MLS). Results from a holding net study indicate that mortality levels amongst lip-hooked snapper caught shallower than 35 m were low.

Estimates for incidental mortality were based on other catch-at-sea data using an age-length structure model for longline, trawl, seine, and recreational fisheries. In SNA 1, estimates of incidental mortality for the year 2000 from longlines were less than 3% and for trawl, seine, and recreational fisheries between 7% and 11% (Millar et al 2001). In SNA 8, estimates of trawl and recreational incidental mortality were lower, mainly because of low numbers of 2- and 3-year old fish estimated in 2000.

With the introduction of Electronic Reporting in 2019, commercial fishers must provide comprehensive reporting of all discards and returns. All fish under the minimum legal size ("sub-MLS fish”) must be returned to the sea.

In SNA 1, recreational fishers release a high proportion of their snapper catch, most of which was less than 30 cm (recreational MLS). An at-sea study in 2006–07 recorded snapper release rates of 54.2% of the catch by trailer boat fishers and 60.1% of the catch on charter boats (Holdsworth & Boyd 2008). Incidental mortality estimated from condition at release was 2.7% to 8.2% of total catch by weight depending on assumptions used.

2. BIOLOGY

Snapper are demersal fish found down to depths of about 200 m, but are most abundant in 15–60 m. They are the dominant fish in northern inshore communities and occupy a wide range of habitats, including rocky reefs and areas of sand and mud bottom. They are widely distributed in the warmer waters of New Zealand, being most abundant in the Hauraki Gulf.

Although all snapper undergo a female phase as juveniles, after maturity each individual functions as one sex (either male or female) during the rest of its life. Sexual maturity occurs at an age of 3–4 years and a length of 20–28 cm; and the sex ratio of the adult population is approximately 50:50. Snapper are serial spawners, releasing many batches of eggs over an extended season during spring and summer. The larvae have a relatively short planktonic phase which results in the spawning grounds corresponding fairly closely with the nursery grounds of young snapper. Juvenile snapper (0+) are known to reach high abundances in shallow west and east coast harbours and estuaries around the northern half of the North Island and have also been observed in catches from trawl surveys conducted in shallow coastal waters around northern New Zealand, East Cape, Hawke Bay and Tasman Bay and Golden Bay. Despite observations of spawning condition adults along the Wairarapa and Kapiti coasts, 0+ snapper have yet to be found in these areas. Young snapper disperse more widely into less sheltered coastal areas as they grow older. Large schools of snapper congregate before spawning and move on to the spawning grounds, usually in November–December. The spawning season may extend to January–March in some areas and years before the fish disperse, often inshore to feeding grounds. The winter grounds are thought to be in deeper waters where the fish are more widespread.

Water temperature appears to play an important part in the success of recruitment. Generally strong year classes in the population correspond to warm years, weak year classes correspond to cold years (Francis 1993).

Growth rate varies geographically and from year to year. Snapper from SNA 2, Tasman Bay/Golden Bay and off the west coast of the North Island grow faster and reach a larger average size than elsewhere. Snapper have a strong seasonal growth pattern, with rapid growth from November to May, and then a slowing down or cessation of growth from June to September. They may live up to 60 years or more and have very low rates of natural mortality. An estimate of $M = 0.06\ yr^{-1}$ was made from catch curves of commercial catches from the west coast North Island pair trawl fishery in the mid-1970s. These data were re-analysed in 1997 and the resulting estimate of $0.075\ yr^{-1}$ has been used in the base case assessments for SNA 1, 2, 7, and 8.

Regular sampling has provided evidence that growth rates of snapper in SNA 1, SNA 7 and SNA 8 have also varied over time. For SNA 8, growth rates were considerably higher during the 1980s and 1990s compared with the 1970s and more recent period (from mid-2000s). The SNA 7 and SNA 8 growth parameters in Table 7 were derived from age-length observations from the early 1990s and, hence, represent the period of higher growth rates. The temporal variation in growth may indicate density-dependence in the growth rates of snapper, at least in SNA 1, SNA 7 and SNA 8, given the historical exploitation patterns of those stocks. Estimates of biological parameters relevant to stock assessment are shown in Table 7.

Table 7: Estimates of biological parameters.

Fishstock	Estimate			Source
1. Instantaneous rate of natural mortality (*M*)				
SNA 1, 2, 7, & 8	0.075			Hilborn & Starr (unpub. analysis)
2. Weight = a(length)^b (Weight in g, length in cm fork length)				
All	a = 0.04467	b = 2.793		Paul (1976)
3. von Bertalanffy growth parameters				
	Both sexes combined			
	K	t_0	L_∞	
SNA 1	0.102	-1.11	58.8	Gilbert & Sullivan (1994)
SNA 2	0.061	-5.42	68.9	NIWA (unpub. analysis)
SNA 7 (1990s)	0.122	-0.71	69.6	MPI (unpub. data)
SNA 8 (1990s)	0.16	-0.11	66.7	Gilbert & Sullivan (1994)
4. Age at recruitment (years)				
SNA 1*	4 (39%) 5 (100%)			Gilbert et al (2000)
SNA 7	3			MPI (unpub. data)
SNA 8	3			Gilbert & Sullivan (1994)

* For years when not estimated.

3. STOCKS AND AREAS

New Zealand snapper are thought to comprise either seven or eight biological stocks based on: the location of spawning and nursery grounds; differences in growth rates, age structure, and recruitment strength; and the results of tagging studies. These stocks are assumed to comprise three in SNA 1 (East Northland, Hauraki Gulf, and Bay of Plenty (BoP)), two in SNA 2 (one of which may be associated with the BoP stock), two in SNA 7 (Marlborough Sounds and Tasman Bay/Golden Bay) and one in SNA 8. Tagging studies reveal that limited mixing occurs between the three SNA 1 biological stocks, with greatest exchange between BoP and Hauraki Gulf.

Tagging studies in SNA 8 have shown considerable movements of fish between South Taranaki Bight and the area north of Cape Egmont. However, recent *Kaharoa* WCNI trawl surveys indicate some differences in the age structure of snapper between the two areas which may suggest a degree of spatial stratification of the SNA 8 stock.

Tagging studies in SNA 7 (1986/87) and SNA 8 (1990) revealed reciprocal movements of snapper between Tasman Bay/Golden Bay and South Taranaki Bight, although the scale of the movement was relatively low during that period.

Location-based snapper catch data from the trawl fisheries in SNA 7 and southern SNA8 has revealed an overlap of the distribution of snapper catches in western approaches to Cook Strait between Durville Island and Kapiti Island, particularly since 2014/15. Snapper age compositions are available from recent (2018-2020) *Kaharoa* trawl surveys of the South Taranaki Bight and the Tasman Bay/Golden Bay area of the WCSI trawl survey. There are strong differences in the relative strength of individual year classes from the 2019 South Taranaki Bight age composition compared to the 2018 and 2020 surveys, while the 2019 STB age composition was very similar to the age structures from the 2019 Tasman Bay/Golden Bay trawl survey and the commercial fishery in the TBGB area. These observations indicate a degree of mixing of the snapper populations between SNA 7 and the STB area (SNA8), although the extent of mixing may vary between years, potentially related to variation in the timing of the main spawning period in each area.

4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

This section was last updated from the 2022 Fisheries Assessment Plenary. An issue-by-issue analysis is available in the Aquatic Environment and Biodiversity Annual Review 2021 (Fisheries New Zealand 2021), online at https://www.mpi.govt.nz/dmsdocument/51472-Aquatic-Environment-and-Biodiversity-Annual-Review-AEBAR-2021-A-summary-of-environmental-interactions-between-the-seafood-sector-and-the-aquatic-environment.

4.1 Role in the ecosystem

Snapper are one of the most abundant demersal generalist predators found in the inshore waters of northern New Zealand (Morrison & Stevenson 2001, Kendrick & Francis 2002), and as such are likely to be an important part of the coastal marine ecosystem (Salomon et al 2008). Localised depletion of snapper probably occurs within the key parts of the fisheries (Parsons et al 2009), and this has unknown consequences for ecosystem functioning in those areas.

4.1.1 Trophic interactions

Snapper are generalists, occupying nearly every coastal marine habitat less than 200 m deep. Because of this generalist nature there is a large potential for a variety of trophic interactions to involve snapper. The diet of snapper is diverse and opportunistic and largely includes crustaceans, polychaetes, echinoderms, molluscs, and other fish (Godfriaux 1969, Godfriaux 1974). As snapper increase in size, harder bodied and larger diet items increase in importance (e.g., fish, echinoids, hermit crabs, molluscs, and brachyuran crabs) (Godfriaux 1969, Usmar 2012). There is some evidence to suggest a seasonal component to snapper diet, with high proportions of pelagic items (e.g., salps and pelagic fish such as pilchards) observed during spring in one study (Powell 1937).

There is some evidence to suggest that snapper can influence the environment that they occupy in some situations. On some rocky reefs, recovery of predators inside marine reserves (including snapper and rock lobster, *Jasus edwardsii*) has led to the recovery of algal beds through predation exerted on herbivorous urchins (Babcock et al 1999, Shears & Babcock 2002). Snapper competes with other species; overlap in diet is likely with a number of other demersal predators (e.g., tarakihi, red gurnard, trevally, rig, and eagle ray). The wide range of prey consumed by these species and differences in diet preference and habitat occupied, however, is likely to reduce the amount of competition overall (Godfriaux 1970, 1974). The importance of snapper as a food source for other predators is poorly understood.

4.1.2 Ecosystem Indicators

Tuck et al (2009) used data from the Hauraki Gulf trawl survey series (up to 2000) to derive fish-based ecosystem indicators using diversity, fish size, and trophic level. This trawl survey series covers a key component of the distribution of snapper. Tuck et al (2009) showed decreasing trends in the proportion of species with low resilience (from FishBase, Froese & Pauly 2000) and the proportion of demersal fish species in waters shallower than 50 m in the Hauraki Gulf. Several indices of fish diversity showed significant declines in muddy waters shallower than 50 m, especially in the Firth of Thames. Tuck et al (2009) did not find size-based indicators as useful as they have been overseas, but there was some indication that the maximum size of fish has decreased in the Hauraki Gulf survey area, especially over sandy bottoms. Since 2008, routine measurement of all fish species in New Zealand trawl surveys has been undertaken and this may increase the utility of size-based indicators in the future.

4.2 Bycatch (fish and invertebrates)

Snapper in SNA 1 is the declared target species, but tends to be more of a bycatch species in SNA 2, SNA 7 and SNA 8, particularly in inshore trawl fisheries. No summaries of observed fish and invertebrate bycatch in snapper target fisheries are currently available, although there is extensive information on commercial bycatch, which is documented in stock characterisations routinely undertaken.

4.3 Incidental capture of protected species (mammals, seabirds, turtles, and protected fish)

For protected species, capture estimates presented here include all animals recovered to the deck (alive, injured, or dead) of fishing vessels but do not include any cryptic mortality (e.g., seabirds struck by a warp or caught on a hook but not brought onboard the vessel, Middleton & Abraham 2007, Brothers et al 2010).

4.3.1 Marine mammal captures

There were two observed captures of New Zealand fur seals in trawls targeting snapper between 2002–03 and 2019–20, but historically low observer coverage of inshore trawlers (average 6.98% in FMAs 1 and 9 between 2002–03 and 2017–18, but averaging 20.51% between 2013–14 and 2017–18) (https://psc.dragonfly.co.nz/2019v1/released/new-zealand-fur-seal/inshore-trawl/all-vessels/eez/2002-03-2017-18/) means that the frequency of captures is highly uncertain. In the same time period, there were no observed marine mammal captures in snapper longline fisheries, when coverage has averaged 2.18% of hooks set (2.5 and 7.3% in the two most recent years) (Protected species bycatch (protectedspeciescaptures.nz)).

Observers recorded two dolphin deaths during snapper trawling in 2016–17: one common dolphin from off the North Island east coast and one bottlenose dolphin from the Northland-Hauraki Gulf area (Abraham et al 2021).

4.3.2 Seabird interactions and captures

There have been thirteen observed captures of seabirds (3 flesh-footed shearwater, 3 black petrel, 2 shearwaters that were not identified further, and 2 common diving petrel, 2 New Zealand white-faced storm petrel and an unidentified small seabird) and 26 observed deck strikes (10 common diving petrels, 10 grey-faced petrel, 2 Buller's shearwater, 1 flesh-footed shearwater, 1 cape petrel, 1 black petrel, and 1 Cook's petrel) in trawls targeting snapper between 2002–03 and 2019–20, but historically low observer coverage of inshore trawlers (average 6.98% in FMAs 1 and 9 between 2002–03 and 2017–18, but averaging 20.51% between 2013–14 and 2017–18) means that the frequency of interactions is highly uncertain. (Protected species bycatch (protectedspeciescaptures.nz))

The estimated number of total incidental captures of all seabirds in the snapper bottom longline fishery declined from 3436 in 2000–01 to 247–644 in 2003–04 (depending on the model used, Table 8, estimates from MacKenzie & Fletcher 2006, Baird & Smith 2007, 2008, Abraham & Thompson 2011a). The estimated number of captures between 2003–04 and 2006–07 appears to have been relatively stable at about 400–600 birds each year.

Table 8: Model based estimates of seabird captures in the SNA 1 bottom longline fishery from 1998–99 to 2006–07 (from MacKenzie & Fletcher 2006 (for vessels under 28 m), Baird & Smith 2007, 2008, Abraham & Thompson 2011a). Numbers in parentheses are 95% confidence limits or estimated CVs.

Fishing year	MacKenzie & Fletcher		Baird & Smith		Abraham & Thompson	
1998–99	1 464	(271–9 392)	–	–	–	–
1999–00	2 578	(513–13 549)	–	–	–	–
2000–01	3 436	(697–17 907)	–	–	–	–
2001–02	1 856	(353–11 260)	–	–	–	–
2002–03	1 583	(299–9 980)	–	–	739	(332–1 997)
2003–04	247	(51–1 685)	546	(CV = 34%)	644	(301–1 585)
2004–05	–	–	587	(CV = 42%)	501	(245–1 233)
2005–06	–	–	–	–	469	(222–1 234)
2006–07	–	–	–	–	457	(195–1 257)

Between 2002–03 and 2017–18, there were 156 observed captures of birds in snapper bottom longline fisheries (Table 9). Estimates of the mean total seabird captures from 2002–03 to 2017–18 vary from 713 to 325 based on a consistent capture rate. The rate of capture varied between 0.0 and 0.1 birds per 1000 hooks observed, fluctuating without obvious trend. Seabirds observed captured in snapper longline fisheries were mostly flesh-footed shearwater (53%) and black (Parkinson's) petrel (24%), and the majority were taken in the Northland-Hauraki area (88%) (Table 10). These numbers should be regarded as only a general guide on the composition of captures because the observer coverage is low, is not uniform across the area, and may not be representative.

Table 9: Number of tows by fishing year, observed, and estimated seabird captures in the snapper bottom longline fishery, 2002–03 to 2019–20. No. obs, number of observed hooks; % obs, percentage of hooks observed; Rate, number of captures per 1000 observed hooks. Estimates are based on methods described by Abraham et al (2016) and Abraham & Richard (2017, 2018) and are available via [Protected species bycatch (protectedspeciescaptures.nz)](protectedspeciescaptures.nz). Observed and estimated protected species captures in this table derive from the PSC database version PSCV6.

		Fishing effort		Observed captures		Estimated captures		
	All hooks	No. obs	% obs	Number	Rate	Mean	95% c.i.	% included
2002–03	13 728 672	0	0.0	0	–	713	522-942	93.2
2003–04	12 266 197	187 282	1.5	10	0.05	636	471-850	100.0
2004–05	11 542 491	244 692	2.1	13	0.05	573	421-766	100.0
2005–06	11 695 613	116 288	1.0	12	0.10	454	324-622	93.1
2006–07	10 348 741	62 360	0.6	0	0.00	438	319-599	93.4
2007–08	9 047 522	0	0.0	0	–	426	302-583	100.0
2008–09	8 981 466	318 274	3.5	27	0.08	441	322-594	100.0
2009–10	11 041 405	634 145	5.7	32	0.05	471	343-633	100.0
2010–11	11 343 582	0	0.0	0	–	497	356-676	100.0
2011–12	11 037 136	0	0.0	0	–	446	318-613	100.0
2012–13	10 501 460	366 120	3.5	2	0.01	418	301-567	100.0
2013–14	11 122 634	747 597	6.7	47	0.06	426	315-573	100.0
2014–15	10 845 182	0	0.0	0	–	356	250-492	100.0
2015–16	10 611 551	337 125	3.2	7	0.02	336	238-463	100.0
2016–17	10 757 586	486 700	4.5	5	0.01	338	235-469	100.0
2017–18	10 427 687	327 091	3.1	14	0.04	325	228-447	100.0
2018–19	10 811 176	269 659	2.5	3	0.01	354	245-485	100.0
2019–20	11 067 703	806 795	7.3	14	0.02	363	260-495	100.0

The snapper target bottom longline fishery contributes to the total risk posed by New Zealand commercial fishing to seabirds (Table 11). The two species to which the fishery poses the most risk are black petrel and flesh-footed shearwater, with this target fishery posing 0.4421 and 0.2166 of PST, respectively (Table 11). The black petrel is assessed at very high risk from commercial fishing in New Zealand waters, and the flesh-footed shearwater is assessed at high risk from commercial fishing in New Zealand waters (Richard et al 2020).

Table 10: Number of observed seabird captures in the snapper longline fishery, 2002–03 to 2018–19, by species or species group. The risk category is an estimate of aggregate potential fatalities across trawl and longline fisheries relative to the Population Sustainability Threshold, PST (from Richard et al 2017, where full details of the risk assessment approach can be found). Observed and estimated protected species captures in this table derive from the PSC database version PSCV4, www.data.dragonfly.co.nz/psc.

Taxa	Risk category	Northland and Hauraki	Bay of Plenty	West Coast North Island	Taranaki
Black petrel	Very high	40	0	0	0
Flesh-footed shearwater	High	76	11	0	7
Northern giant petrel	Medium	1	0	0	0
Pied shag	Negligible	2	0	0	0
Fluttering shearwater	Negligible	6	0	0	0
Sooty shearwater	Negligible	2	0	0	0
Australasian gannet	Negligible	2	0	0	0
Buller's shearwater	Negligible	13	0	1	0
Southern black-backed gull	Negligible	5	0	0	0
Petrels	–	3	1	0	1
Total birds	–	163	14	1	8

Table 11: Risk ratio of seabirds predicted by the risk assessment for the snapper target bottom longline fishery and all fisheries included in the risk assessment, 2006–07 to 2016–17, showing seabird species with a risk ratio of Very High or High; estimates at a fishery-specific level were not available for other species. The risk ratio is an estimate of aggregate potential fatalities across trawl and longline fisheries relative to the Population Sustainability Threshold, PST (from Richard et al 2017, where full details of the risk assessment approach can be found). The DOC threat classifications are given by (Robertson et al 2017 at http://www.doc.govt.nz/documents/science-and-technical/nztcs19entire.pdf).

		Risk ratio			
Species name	PST (mean)	SNA target bottom longline	Total	Risk category	DOC Threat Classification
Black petrel	447	0.4421	1.23	Very high	Threatened: Nationally Vulnerable
Flesh-footed shearwater	1 450	0.2166	0.49	High	Threatened: Nationally Vulnerable

4.3.3 Sea turtle captures

Between 2002–03 and 2019–20 there was one observed capture of a green turtle in the snapper bottom longline fishery occurring in the Northland and Hauraki fishing area. Observer records documented the green turtle as captured and released alive (Fisheries New Zealand unpublished data). In the same period, there were no captures of turtles in the snapper trawl fishery.

4.3.4 Protected fish captures

White pointer sharks (*Carcharodon carcharias*, also known as great white shark) were protected in New Zealand waters in 2007 under the Wildlife Act 1953, but they are incidentally caught in commercial and recreational fisheries (Francis & Lyon 2012). Fishers have reported catching a total of 24 white pointer shark individuals in snapper trawls since 2009, 4 of which were dead upon capture, 5 were released alive but injured, and the remainder were released alive. Little is known about the survival of released individuals, but it is assumed to be low.

4.4 Benthic interactions

The spatial extent of seabed contact by trawl fishing gear in New Zealand's EEZ and Territorial Sea has been estimated and mapped for all trawl fisheries combined (Baird & Mules 2021). This most recent analysis provides an assessment of the inshore trawl footprint was for the period 2007–08 to 2020-21 (MacGibbon & Mules 2023).

A total of almost 49 700 bottom contacting tows have targeted snapper between 2007–08 and 2020–21. Annual numbers fluctuated around 4000 tows per year up to 2012–13 but have declined to around 2400 since 2015–16 (MacGibbon & Mules 2023). The total aggregate area fished between 2007–08 and 2020-21 was 55 629 km^2. This has mostly (67%) been within SNA 1, where annual aggregate area fished declined from around 3000 km^2 (2007–08 to 2012–13) to 2100 km^2 (2016–17), before increasing to around 3000 km^2 (2017–18 and 2020–21). Annual area fished within SNA 2 and SNA 7 has fluctuated around 350 km^2; whereas in SNA 8, the annual area fished declined from 1300 km^2 in 2007–08 to 480 km^2 by 2010–11 and has fluctuated around this level since this time (MacGibbon & Mules 2023).

A proportion of the commercial catch of snapper is taken using bottom trawls in Benthic Optimised Marine Environment Classification (BOMEC, Leathwick et al 2012) classes A, C (northern shelf), and H (shelf break and upper-slope) (Baird & Wood 2012), and at least 90% of trawls occur shallower than 100 m depth (Baird et al 2011, tabulating data from TCEPR forms). Trawling for snapper, like trawling for other demersal species, is likely to have effects on benthic community structure and function (e.g., Thrush et al 1998, Rice 2006) and there may be consequences for benthic productivity (e.g., Jennings et al 2001, Hermsen et al 2003, Hiddink et al 2006, Reiss et al 2009). These consequences are not considered in detail here but are discussed in the Aquatic Environment and Biodiversity Annual Review 2021 (Fisheries New Zealand 2021).

4.5 Other considerations

4.5.1 Spawning disruption

Fishing within aggregations of spawning fish may have the potential to disrupt spawning behaviour and, for some fishing methods or species, may lead to reduced spawning success. No research has been conducted on disruption of snapper spawning, but aggregations of spawning snapper often receive high commercial and recreational fishing effort (Fisheries New Zealand unpublished data). Areas likely to be important for snapper spawning include the Hauraki Gulf (Cradock Channel, Coromandel Harbour to the Firth of Thames, and between the Noises, Tiritiri Matangi, and Kawau Islands (Zeldis & Francis 1998)), Rangaunu and Doubtless Bay, the Bay of Islands, eastern Bay of Plenty, and the coastal areas adjacent to the harbour mouths on the west coast such as Manukau Harbour and Kaipara Harbour (Hurst et al 2000).

4.5.2 Genetic effects
Fishing, environmental changes, including those caused by climate change or pollution, could alter the genetic composition or diversity of a species. Bernal-Ramírez et al (2003) estimated genetic diversity and confidence limits for snapper in Tasman Bay and the Hauraki Gulf. They showed a significant decline of both mean heterozygosity and mean number of alleles in Tasman Bay, but only random fluctuations in the Hauraki Gulf. In Tasman Bay, there was a decrease in genetic diversity at six of seven loci examined, compared with only one in the Hauraki Gulf. Bernal-Ramírez et al (2003) associated this decline with overfishing of the SNA 7 stock and estimated the effective population size in Tasman Bay declined to a low level between 1950 and 1998.

4.5.3 Habitat of particular significance to fisheries management
Habitat of particular significance for fisheries management (HPSFM) does not have a policy definition (Ministry for Primary Industries 2013). For juvenile snapper, it is likely that certain habitats, or locations, are critical to successful recruitment of snapper. Post settlement juvenile snapper (10–70 mm fork length) associate strongly with three-dimensional structured habitats in estuaries, harbours, and sheltered coastal areas (such as beds of seagrass and horse mussels, Thrush et al 2002, Morrison et al 2009, 2014a, b). The reason for this association is currently unclear, but the provision of food and shelter are likely explanations. Some potential nursery habitats appear to contribute disproportionately to their area. For example, the Kaipara Harbour in northern New Zealand contributed to more than 75% of the recruits to the SNA 8 fishery in 2003 (Morrison, NIWA, unpublished data, Morrison et al 2009) and a similar situation exists for snapper from Port Phillip Bay in Australia (Hamer et al 2011). These habitats are subject to land-based stressors (Morrison et al 2009, Lowe et al 2015) that may affect the survival of juvenile snapper and hence recruitment to the SNA 8 fishery. It should, however, be noted that recruitment over the last decade has been exceptionally good, suggesting that environmental factors affecting egg and larval survival in the ocean have had greater influence on the number of fertilised eggs surviving to adulthood.

5. RECRUITMENT, ENVIRONMENTAL VARIABILITY, AND CLIMATE CHANGE

This section was last updated in May 2021.

Recruitment dynamics are challenging to assess or predict because of the many underlying drivers that vary over time and space. Stock size, demographic and trait composition, condition and distribution of spawning fish, and the spatio-temporal dynamics of trophic and environmental interactions all influence recruitment processes. Annual variations in snapper recruitment have considerable impact on this fishery and improved understanding of the influence of environmental variables on recruitment patterns would be very useful for the future projection of stock size under different climate change scenarios and different environmental conditions.

New Zealand waters are becoming warmer and more acidic due to the emission of anthropogenic carbon dioxide (Law et al 2018a, 2018b). Recruitment success of New Zealand snapper has been highly correlated with warmer conditions (Francis 1993, Harley & Gilbert 2000, Zeldis et al 2005, Dunn et al 2009, Langley 2015, Garg 2020). Snapper recruitment fluctuations may significantly influence biomass where: 1) a series of weak or strong year classes occur in adjacent years, 2) a population is heavily fished and thus more easily dominated by younger year classes, or 3) a population is near the geographic limit of its range and is dominated by a few year classes due to irregular recruitment; each of which has occurred in at least one snapper stock in New Zealand (Francis 1993).

Recruitment in SNA 7 and SNA 8 has been above average in recent years (Langley 2020a, 2020b). Some spatial differences in year class strength (YCS) patterns are evident across different stocks, but appear to be reasonably well correlated, which may be a result of each stock showing similar responses to broad climatic phenomena, such as the Southern Oscillation Index (SOI) (Francis & Mackenzie 2015). Stock assessments have estimated high levels of recruitment in SNA 7 and SNA 8 between 2006 and 2019 (Langley 2015, 2020a, 2020b), which may possibly be linked to increasing water temperatures. It should nevertheless be noted that the relationship between recruitment and water temperature is unlikely to be linear, with growth and recruitment decreasing after reaching an optimum thermal maxima for Australian snapper populations (Fowler & Jennings 2003, Murphy 2013). It is unclear what the thermal maxima will be for snapper in New Zealand.

In SNA 7, recruitment has been shown to be positively correlated with air temperature (Harley & Gilbert 2000). Strong year classes have also been linked to positive SOI conditions, whereas weak year classes have been linked to negative SOI conditions (Langley 2015). More recently, Garg (2020) examined environment-recruitment relationships for SNA 1 (1970–2007) and SNA 7 (1982–2012) using generalised linear models based on annual recruitment estimates from stock assessment models that incorporated age data from otolith samples. The most variation in YCS was explained by the mean autumn (April–June) SST in SNA 1 and by mean annual SOI in SNA 7, and the Interdecadal Pacific Oscillation accounted for the second greatest amount of variation in both SNA 1 and SNA 7. These findings were consistent with Francis (1993), who concluded that water temperature appears to play an important part in the success of recruitment, with strong year classes in the population generally corresponding to warm years, and weak year classes to cold years. As well as finding a positive correlation between YCS and SST, Dunn et al (2009) also found a positive correlation between YCS and SOI for SNA 1.

A recent study found that fishing and environmental factors initially promote individual fish growth of snapper, but regional-scale wind and temperature may also increase the sensitivity of stocks to environmental change (Morrongiello et al 2021).

Temperature-recruitment relationships are typically non-linear, and studies on snapper in South Australia have shown a reduction in recruitment after temperatures rose above 25 °C (Fowler & Jennings 2003). In Western Australia, snapper growth is greatest at mid latitudes with more moderate temperatures, and lowest at the northern limit of the geographical range for snapper, where temperatures are at their highest (Wakefield et al 2017). In South Australia, biochronology work has found an optimal temperature maximum of 18–20 °C for growth in snapper, and temperatures greater than this result in slower growth rates (Martino et al 2019), which was also in support of optimum growth conditions for juvenile snapper ascertained from aquaculture experimental studies (Fielder et al 2005). The Hauraki Gulf is currently experiencing temperatures near 20 °C, but the optimal temperature range for snapper stocks in New Zealand is unknown (Parsons et al 2020). Recent Hauraki and Bay of Plenty trawl surveys which monitored snapper recruitment and compared it to SST show that the estimated year class strength of 1+ and 2+ snapper in the Hauraki Gulf 2019 survey was well above the long-term average, whereas in the Bay of Plenty, YCSs were well above average (1+) and about average (2+) (see Parsons & Bian in prep).

Several causal mechanisms may result in the increased production of prey and a faster larval growth rate of snapper (Murphy 2013). Zeldis et al (2005) found that wind-driven upwelling caused increased flux of shelf water into the Hauraki Gulf, resulting in greater primary productivity, prey abundance, and higher larval snapper survival.

Ocean acidification (OA) has been shown to have a variable influence on snapper larvae. Although higher temperature and carbon dioxide levels may positively impact growth and survival of snapper larvae, this effect may be countered by the negative effects of elevated carbon dioxide on metabolic rates and swimming performance (McMahon et al 2020a, 2020b). Modelling the overall effect from both OA and warming on snapper populations estimated a 29% reduction to a 44% increase in fishery yield and therefore remains highly uncertain (Parsons et al 2020).

Cummings et al (2021) assessed the vulnerability of New Zealand's snapper fishery to projected environmental change as 'moderate' and outlined the following potential outcomes of increased sea temperatures: 1) southward range expansion, 2) change in distribution of predators, competitors, parasites, and disease, and 3) toxicity and decreased dissolved oxygen due to harmful algal blooms. In recent years, snapper populations appear to have been increasing, in some areas substantially, suggesting that environmental conditions are currently favourable for snapper recruitment and survival.

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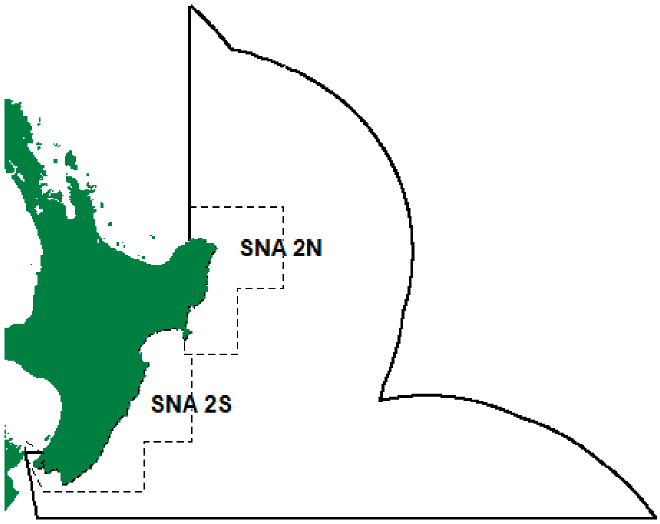
SNAPPER (SNA 2)

(*Chrysophrys auratus*)
Tamure, Kouarea



1. FISHERIES SUMMARY

1.1 Commercial fisheries

Table 1 and Table 2 provide a summary of the reported commercial catches, TACCs, and TACs for SNA 2. Landings and TACCs are plotted in Figure 1.

Table 1: Reported landings (t) of snapper from SNA 2 from 1931 to 1990.

Year	Landings (t)	Year	Landings (t)	Year	Landings (t)
1931–32	0	1951	265	1971	861
1932–33	0	1952	220	1972	878
1933–34	21	1953	247	1973	798
1934–35	168	1954	293	1974	716
1935–36	149	1955	309	1975	732
1936–37	78	1956	365	1976	732
1937–38	114	1957	452	1977	374
1938–39	122	1958	483	1978	454
1939–40	100	1959	372	1979	662
1940–41	103	1960	487	1980	636
1941–42	148	1961	589	1981	283
1942–43	74	1962	604	1982	160
1943–44	60	1963	636	1983	160
1944	49	1964	667	1984	227
1945	59	1965	605	1985	208
1946	77	1966	744	1986	255
1947	36	1967	856	1987	122
1948	53	1968	765	1988	165
1949	215	1969	837	1989	227
1950	285	1970	804	1990	429

Notes:
1. The 1931–1943 years are April–March but from 1944 onwards are calendar years.
2. The ‘QMA totals’ are approximations derived from port landing subtotals, as follows: SNA 2 Gisborne to Wellington/Makara
3. Before 1946 the ‘QMA’ subtotals sum to less than the New Zealand total because data from the complete set of ports are not available.
4. Data up to 1985 are from fishing returns: data from 1986 to 1990 are from Quota Management Reports.
5. Data for the period 1931 to 1982 are based on reported landings by harbour and are likely to be underestimated as a result of under-reporting and discarding practices. Data include both foreign and domestic landings.

In SNA 2, snapper is primarily caught as a bycatch of the tarakihi and gurnard bottom trawl fisheries and, more intermittently, in the gurnard target Danish seine fishery. From 1 October 2002, the TACC for SNA 2 was increased from 252 t to 315 t, within a total TAC of 450 t (Table 3). Nevertheless the 315 t TACC has regularly been over-caught since 1987–88, except in the fishing years 2008–09 to 2009–10 and 2012–13 to 2014–15. The minimum legal size (MLS) for snapper in SNA 2 is 25 cm.

Table 2: Reported landings (t) of snapper from SNA 2 from 1983–84 to present and gazetted and actual TACCs (t) for 1986–87 to present. QMS data from 1986–present.

Fishstock	SNA 2	
FMAs	2	
	Landings	TACC
1983–84†	145	–
1984–85†	163	–
1985–86†	177	–
1986–87	130	130
1987–88	152	137
1988–89	210	157
1989–90	364	157
1990–91	428	157
1991–92	373	157
1992–93	324	252
1993–94	307	252
1994–95	308	252
1995–96	280	252
1996–97	351	252
1997–98	286	252
1998–99	283	252
1999–00	390	252
2000–01	360	252
2001–02	252	252
2002–03	334	315
2003–04	339	315
2004–05	399	315
2005–06	389	315
2006–07	329	315
2007–08	328	315
2008–09	307	315
2009–10	296	315
2010–11	320	315
2011–12	358	315
2012–13	310	315
2013–14	313	315
2014–15	271	315
2015–16	321	315
2016–17	373	315
2017–18	373	315
2018–19	364	315
2019–20	330	315
2020–21	321	315
2021–22	337	315
2022–23	339	315

† FSU data. SNA 2 = Statistical Areas 011–016

Table 3: TACs, TACCs, and allowances (t) for SNA 2 from 1 October 2021.

Fishstock	TAC	TACC	Customary allowance	Recreational allowance	Other mortality
SNA 2	450	315	14	90	31

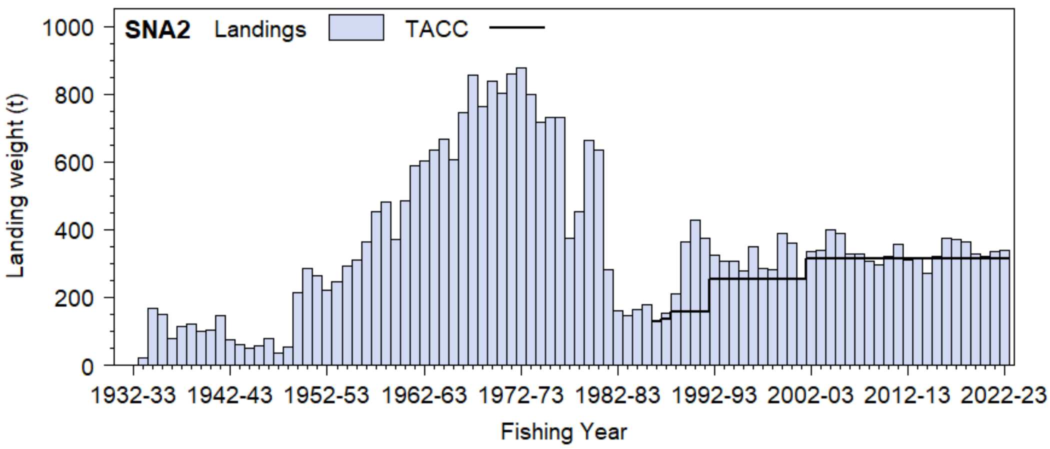


Figure 1: Total reported landings and TACCs for SNA 2.

1.2 Recreational fisheries

The snapper fishery is the largest recreational fishery in New Zealand. It is the major target species on the northeast and northwest coasts of the North Island and is targeted seasonally around the rest of the North Island and the top of the South Island. The current allowance within the SNA 2 TAC is shown in Table 3.

1.2.1 Management controls

The two main methods used to manage recreational harvests of snapper are minimum legal size limits (MLS) and daily bag limits. Both have changed over time (Table 4). The number of hooks permitted on a recreational longline was reduced from 50 to 25 in 1995.

Table 4: Changes to minimum legal size limits (MLS) and daily bag limits used to manage recreational harvesting levels in SNA 2.

Stock	MLS	Bag limit	Introduced
SNA 2	25	30	1/01/1985
SNA 2	27	10	1/10/2005

1.2.2 Estimates of recreational harvest

A background to the estimation on recreational harvest of snapper is provided in the Introduction – Snapper chapter. Recreational harvest estimates for SNA 2 are provided in Table 5a. Partitioned between the SNA 2 sub-areas, the 2017–18 panel survey provides estimates of recreational harvest from SNA 2N of 35 t and SNA 2S of 58 t (Bruce Hartill, NIWA, pers. comm.).

Table 5a: Recreational catch estimates for SNA 2. Totals for a stock are given in bold. The telephone/diary surveys ran from December to November but are denoted by the January calendar year. Mean fish weights were obtained from boat ramp surveys (for the telephone/diary and panel survey catch estimates). Numbers and mean weights are not calculated in the tag ratio method. Amateur charter vessel (ACV) and recreational take from commercial vessels under s111 general approvals as reported, with Total the sum of NPS, ACV and s111. ACVs have only been required to report harvest for SNA since 2020–21.

			Harvest survey					
Stock	Year	Method	Number of fish (0000s)	Estimate (t)	CV	ACV (t)	s111 (t)	Total (t)
SNA 2								
Total	1993	Telephone/diary	28	**36**	–			
Total	1996	Telephone/diary	31	**40**	–			
Total	2000	Telephone/diary	268	**322**	–			
Total	2001	Telephone/diary	144	**173**	–			
Total	2011–12	Panel survey	55	**57**	**0.25**	**0.5**	**0.7**	**57.7**
Total	2017–18	Panel survey	82	**91**	**0.24**	**0.9**	**0.8**	**93.1**
Total	2022–23	Panel survey	88	**116**	**0.25**	**4.4**	**1.1**	**121.9**

Web camera/creel survey monitoring has been undertaken within SNA 2 since 2014–15 (monitoring at Napier and Gisborne). These data show a generally increasing trend in snapper catch rate, but also need to be scaled to fishing effort and the National Panel Survey estimates (2017–18 and 2022–23) in an agreed way (still to be determined) to generate annual harvest estimates (Table 5b).

Table 5b: Preliminary recreational catch rate estimates (kg.trip) from web camera/creel survey monitoring and of National Panel Survey harvest estimates (including charter trip records) for SNA 2, split by SNA 2N and SNA 2S .

	SNA 2N		SNA 2S	
Year	Catch rate (kg.trip)	NPS (t)	Catch rate (kg.trip)	NPS (t)
2011–12		30.3		27.0
2012–13				
2013–14				
2014–15	0.84		1.68	
2015–16	0.95		2.09	
2016–17	1.09		2.48	
2017–18	2.27	35.2	3.54	57.9
2018–19	1.91		4.49	
2019–20	1.77		2.61	
2020–21	2.50		4.31	
2021–22	1.37		2.72	
2022–23	2.03	40.3	5.23	80.0

1.3 Customary non-commercial fisheries
Snapper form important fisheries for customary non-commercial fisheries, but the annual catch is not known. The information on Māori customary harvest under the provisions made for customary fishing is limited and it is likely that Māori customary fishers utilise the provisions under recreational fishing regulations.

1.4 Illegal catch
No new information is available to estimate illegal catch.

1.5 Other sources of mortality
With the introduction of Electronic Reporting in 2019, commercial fishers must provide comprehensive reporting of all discards and returns. All fish under the minimum legal size ("sub-MLS fish”) must be returned to the sea; in SNA 2 reported quantities of sub-MLS snapper have been small (1–3 t in 2020 and 2021).

2. BIOLOGY

For further information on snapper biology refer to the Introduction – Snapper chapter. A summary of published estimates of biological parameters for SNA 2 is presented in Table 6.

Table 6: Estimates of biological parameters.

Fishstock	**Estimate**			**Source**
1. Instantaneous rate of natural mortality (*M*)				
SNA 1, 2, 7, & 8	0.075			Hilborn & Starr (unpub. analysis)
2. Weight = a(length)^b (Weight in g, length in cm fork length)				
All	a = 0.04467	b = 2.793		Paul (1976)
3. von Bertalanffy growth parameters				
	Both sexes combined			
	K	t_0	L_∞	
SNA 2N	0.027	-8.85	98.7	Walsh et al (2012)
SNA 2S	0.097	-2.02	71.7	Walsh et al (2012)

3. STOCKS AND AREAS

A review of catch at age data collected from SNA 2 in 2008 and 2009 found differences in length and age structure, year class strength and growth for snapper in northern and southern subareas of SNA 2 (Walsh et al 2012). The boundary between the areas was defined as the Mahia Peninsula, with most catch from the northern area landed and sampled in Gisborne, and from the southern area in Napier. Previously genetic sampling (Smith et al 1978) suggested that snapper in Hawke Bay were genetically more similar to snapper on the west coast of the North Island than other east coast snapper, and that there was an indication of stock mixing at East Cape between the Bay of Plenty and northern SNA 2. Whole-genome genetic analyses have confirmed that there are two major genetic groupings of snapper in New Zealand (Oosting 2021). Snapper sampled from recreational fisheries in Napier and Gisborne tended to group with snapper from SNA 7 and SNA 8, while snapper from north of East Cape grouped with SNA 1. No samples were obtained between Gisborne and East Cape. Walsh et al (2012) concluded that there was evidence, based on nursery areas, growth rates and year class strength, that the northern and southern areas in SNA 2 represented separate sub-stocks with minor level of mixing and migration occurring between the northern area of SNA 2 and the Bay of Plenty, similar to that seen between the sub-stocks of SNA 1.

4. STOCK ASSESSMENT

A full quantitative stock assessment was completed for SNA 2 in 2009 (Langley 2010). This assessment is not reported here because it assumed that SNA 2 comprised a single biological stock and the Plenary gave it a quality ranking of ‘2’ at the time of review. In 2017, standardised CPUE indices for the two sub-stocks were derived using data from the mixed target bottom trawl fishery for the recent period of the fishery; these have been updated periodically and CPUE-based reference points have been adopted for SNA 2S.

4.1 Standardised CPUE

In 2017, Schofield et al (2018a) completed a standardised CPUE analysis for the two sub-stocks of SNA 2 using commercial catch and effort data from the bottom trawl fishery. Two CPUE series were considered: vessel-day records aggregated to pseudo-CELR resolution (Langley 2014); and tow by tow records from 2008 onwards. Due to changes in regulations and reporting behaviour between 1989–90 and 2001–02, data from this period were excluded from the vessel-day analysis. Throughout this period the SNA 2 TACC was consistently over-caught, in 2000 Annual Catch Entitlement was introduced, in 2001 differential deemed values were introduced, and in 2002 the SNA 2 TACC was increased to 325 t.

The boundary between the northern and southern sub-stocks was assumed to lie off the southern tip of Mahia Peninsula, splitting Statistical Area 013 into Eastern and Western sub-areas at 177.87° E. A classification partitioning model was used to allocate catch and effort reported from Statistical Area 013 on CELR forms to one of the two sub-stocks, trained using high-resolution data from 2007–08 to 2015–16. The partition tree used landing port for the primary split and then target species as a secondary split when landing port was not Auckland, Gisborne, or Tauranga. Actual area (013W or 013E) was correctly assigned for 88.9% of records in the training dataset.

A Generalised Linear Modelling (GLM) approach was applied to separately model the occurrence of snapper catches (presence/absence) and the magnitude of positive snapper catches; these were combined to produce the final series. The presence/absence of snapper catch was modelled based on a binomial distribution. The dependent variable of the catch magnitude CPUE models was the natural logarithm of catch, and the error structure was chosen following an evaluation of alternative distributions.

The Inshore WG adopted the combined vessel day CPUE indices as indices of abundance for the SNA 2 sub-stocks in 2017. These indices were updated in 2018 (Schofield et al 2018b) to include data to 30 September 2017, and again in 2022 with minor modifications (Middleton 2024).

The series were further updated in 2024 with data to 30 September 2023, using lognormal distributions for the vessel-day positive catches and Weibull distributions for the tow by tow series (Middleton 2024). Data included in the event-based series for SNA 2S were limited to Hawke Bay, defined as Statistical Area 013 west of 177.87° E and Statistical Area 014 north of 39.65° S, as a result of evidence that catches of snapper off the coast south of Hawke Bay (within Statistical Area 014) had a disproportionate influence on the indices.

The daily series for the northern sub-stock initially increased from 2002 to 2003, declined from 2003 to 2010 then, following a period of stability from 2010 to 2016, increased steadily to 2023 (Figure 2). The southern sub-stock was stable from 2002 to 2007, dropped to a lower level from 2008 to 2016, before increasing sustantially to 2023.

The event-based series, beginning in 2008, show very similar trends to the daily series for the common years (Figure 2). Trends in abundance in the northern and southern areas are generally similar, but the variation in SNA 2S has been greater, with lower relative abundance from 2013 to 2016, and reaching higher relative abundance in the early 2000s, and in 2023.

Unstandardised recreational harvest rates from creel surveys at boat ramps in Gisborne and Napier showed similar trends to commercial CPUE from 2015 to 2021 but did not increase in 2022 and 2023 (Figure 3).

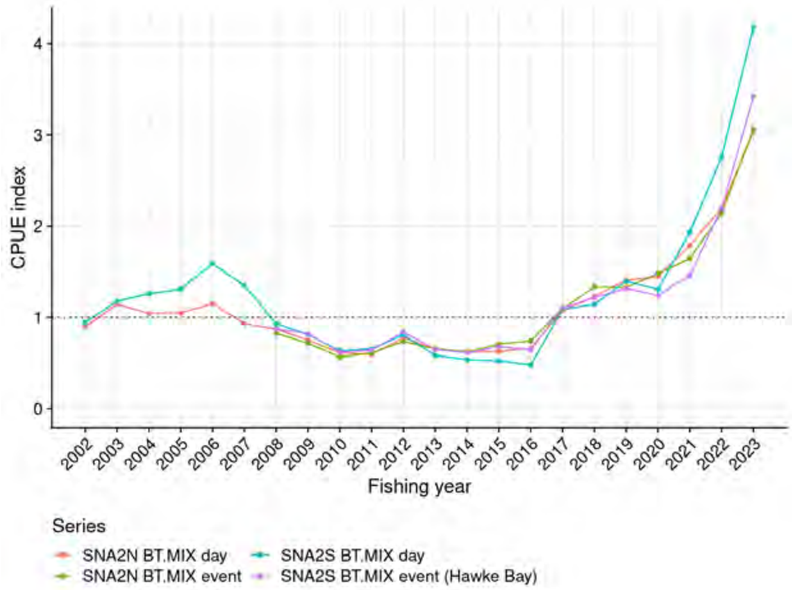


Figure 2: Comparison of standardised combined catch per unit effort (CPUE) indices for the northern and southern sub-stocks of SNA 2 from bottom trawling targeting gurnard, snapper, tarakihi, and trevally combined over all form types and aggregated to CELR resolution (BT.MIX day), and from data reported at the event level (BT.MIX event). Series are scaled relative to the geometric mean of the years they have in common. Fishing years are labelled according to the second calendar year, e.g., 2002 = 2001–02.

Figure 3: Comparison of standardised combined catch per unit effort (CPUE) indices for the northern and southern sub-stocks of SNA 2 from bottom trawling targeting gurnard, snapper, tarakihi, and trevally combined over all form types and aggregated to CELR resolution (BT-MIX daily) with unstandardised recreational harvest rates from monitoring of boat ramps in Gisborne (GSR) and Napier (NAP). Fishing years are labelled according to the second calendar year, e.g., 2002 = 2001–02.

Establishing B_{MSY} compatible reference points

In 2022, the Inshore Working Group adopted geometric mean standardised CPUE from the BT-MIX event-resolution model for the period 2008 to 2012 as the soft limit reference point for SNA 2S. This period had stable catch and standardised CPUE. The historical catch suggested that the stock was at a low point in the early 1980s. The longer daily resolution index (beginning in 2002) indicated that the stock was higher prior to the reference period, but it was thought that it was unlikely it had recovered to be substantially higher than the target by that time. The Working Group adopted the default Harvest Strategy Standard definitions for the target and hard limit of twice and half the soft limit, respectively.

In 2024 the Plenary chose to adopt the Hawke Bay only series [SNA2S BT.mix event (Hawke Bay)] as the reference series, because this avoids disproportionate influence on the indices arising from potential range expansion in areas at the limits of the normal stock distribution. The reference period for defining the soft limit was not changed.

No reference point was adopted for SNA 2N in 2024, because there remains uncertainty regarding the degree of stock relationship with the eastern Bay of Plenty.

4.2 Catch at age data

Seven years of age frequency data were available from the commercial fisheries for the 2009 assessment. There was considerable variability in the age compositions among years, likely due in part to the sampling of the snapper bycatch from a number of different target fisheries. The age compositions were principally composed of younger age classes and few old fish were sampled from the catch. There are concerns regarding the representative nature of the sampling and comparability of the ageing in earlier years.

A further commercial catch sampling programme was conducted in the 2007–08 and 2008–09 fishing years (Walsh et al 2012). The study found evidence for two sub-stocks within SNA 2: a northern stock located between Mahia Peninsula and Cape Runaway, and a southern stock within Hawke Bay. Walsh et al (2012) demonstrated that, although strong year classes were consistent between stocks, a range of year classes were present in the northern area (similar to the eastern Bay of Plenty), whereas the southern area was dominated by a few strong year classes. Snapper from the southern sub-stock grew considerably faster than those from the northern sub-stock weighing 50–60% more at any given age.

Catch sampling was carried out in 2020, in the northern subarea only. Results suggest a higher proportion of 20+ fish in 2020 than in 2008 and 2009. Results from catch sampling in SNA 2N in 2022–23 suggested further broadening of the age distribution, with a strong 2015 year class evident in both 2019–20 and 2022–23, and an indication in the 2022–23 sampling of a strong 2019 year class entering the fishery (Figure 4).

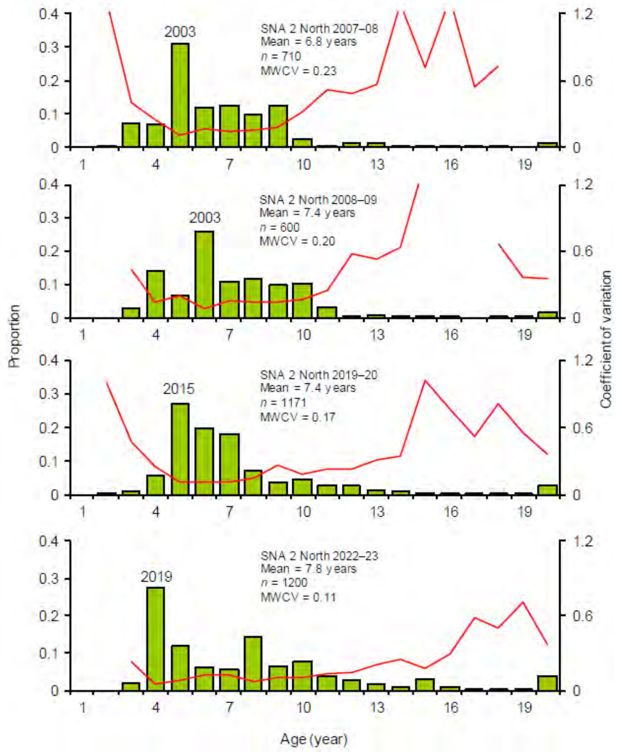


Figure 4 Age distributions of snapper in the SNA 2N bottom trawl fisheries in 2007-08, 2008–09, 2019–20 and 2022–23.

Future research considerations

- Extend whole genome sequencing analysis by including additional samples between Mahia and Cape Runaway to resolve stock relationships between SNA2S, SNA2N and eastern BoP.
- Catch sampling in both northern and southern areas is required to allow similarities and differences in year class strengths to be assessed for years other than 2008 and 2009, and to establish whether changes in growth rates observed in other snapper fisheries have also occurred in SNA 2. This should be conducted in conjunction with sampling within the Bay of Plenty.
- The pre-QMS catch history for SNA 2 requires partitioning between the northern and southern areas.
- Refine the CPUE series, including investigating the effect of splitting vessels that have been in the core fleet for long periods, or have gaps in participation; use a ‘top 8’ event-resolution model with TCER and ERS-Trawl data only; drop trevally target data.
- Further explore the wider area (SNA 2 and Bay of Plenty) CPUE model to investigate stock relationships between SNA 1 and SNA 2
- Explore any additional snapper tagging data as it comes available (e.g., Tindale Marine Research Charitable Trust data) to investigate fish movement.

5. STATUS OF THE STOCKS

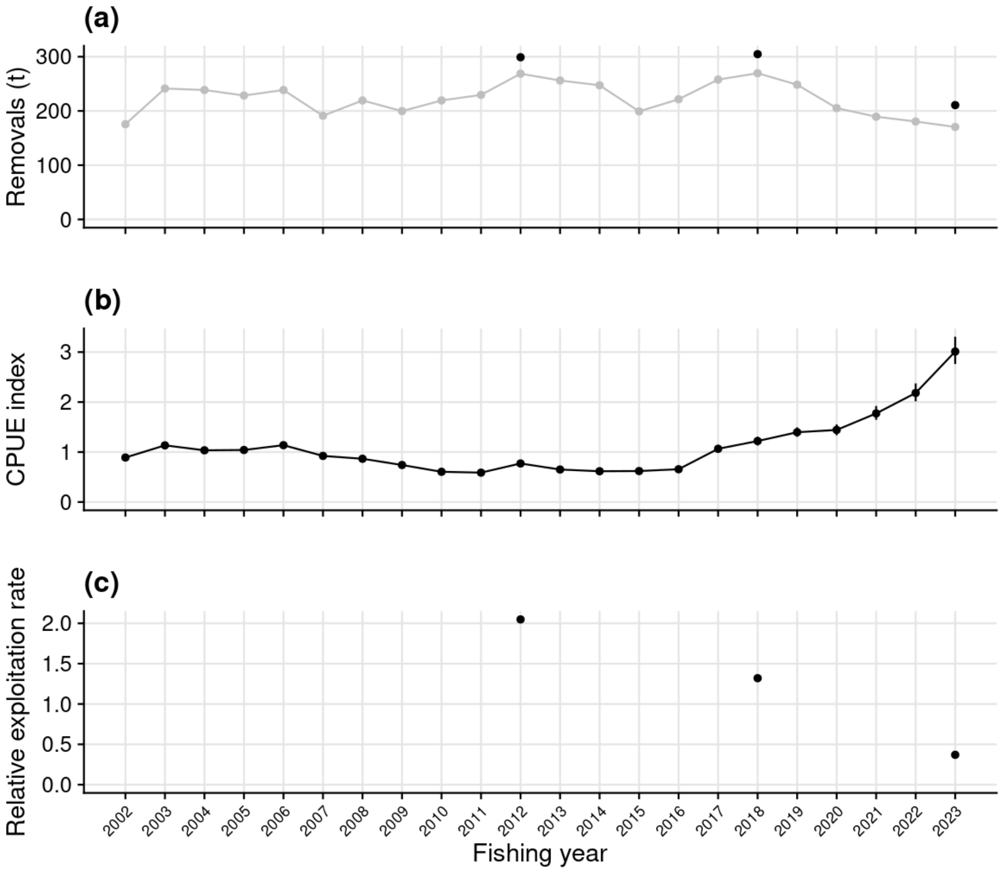
Stock Structure Assumptions

SNA 2 is assumed to occur in two sub-stocks. The northern sub-stock occurs between the southern tip of the Mahia Peninsula and Cape Runaway and may be associated with the SNA 1 Bay of Plenty stock. The southern sub-stock occurs mainly within Hawke Bay and is genetically linked to SNA 7 and SNA 8.

SNA 2N

Stock Status		
Most Recent Assessment Plenary Publication Year	2024	
Catch in most recent year of assessment	Year: 2022–23	Catch: 210 t (170 t commercial, 40 t recreational)
Assessment Runs Presented	Standardised combined CPUE (positive + binomial) model based on daily aggregated SNA, TRE, GUR, and TAR target single trawl data up to 2022–23	
Reference Points	Target: B_{MSY}-compatible proxy based on CPUE: not determined Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: F_{MSY}	
Status in relation to Target	Unknown	
Status in relation to Limits	Soft Limit: Very Unlikely (< 10%) Hard Limit: Very Unlikely (< 10%) Reference points cannot be determined because of uncertainty about the relationship between SNA 2N and BoP, however relative abundance has increased about 4 times from the low period between 2010 and 2016.	
Status in relation to Overfishing	Unknown	

Historical Stock Status Trajectory and Current Status



(a) Annual commercial (grey) and total (black) removals for SNA 2N; (b) the standardised catch per unit effort (CPUE) index for SNA 2N from trawling targeting gurnard, snapper, tarakihi and trevally (BT.MIX day); and (c) relative exploitation rate (for years for which recreational harvest estimates were available).

Fisheries and Stock Trends	
Recent Trend in Biomass or Proxy	The standardised CPUE index was relatively stable from 2010 to 2016 then roughly quadrupled in the period to 2023.
Recent Trend in Fishing Mortality or Proxy	Relative exploitation rate decreased from 2012 to 2023.
Other Abundance Indices	Unstandardised recreational CPUE from 2015 to 2021 increased three-fold but has fluctuated around this level since.
Trends in Other Relevant Indicators or Variables	The proportion of older fish (> 10yrs) in the annual commercial catch has increased from 2007–08 to 2022–23. Two recent strong year classes were observed in 2015 and 2019. A strong 2003 year class is likely to be contributing to the plus group in 2022–23

Projections and Prognosis	
Stock Projections or Prognosis	The stock biomass is likely to continue to increase at current catches, due to two recent strong year classes.
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	For current (1 October 2023) catch levels: Soft Limit: Very Unlikely (< 10%) Hard Limit: Very Unlikely (< 10%) Unknown for current TACC
Probability of Current Catch or TACC causing overfishing to continue or to commence	Unknown

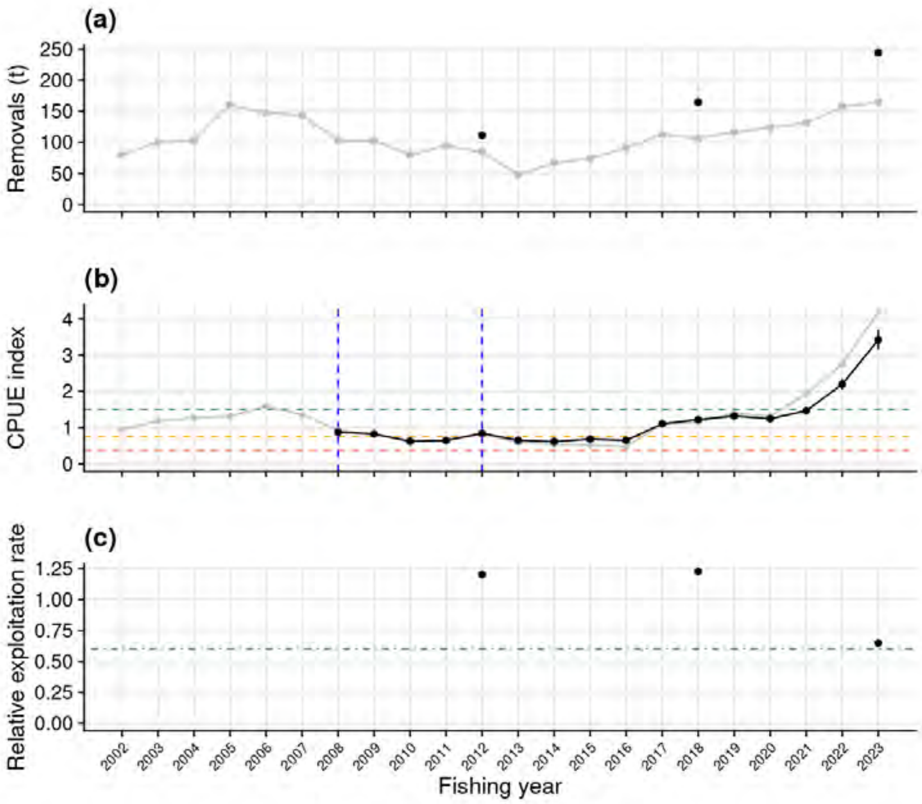
Assessment Methodology		
Assessment Type	Level 2 – Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE	
Assessment Dates	Latest assessment Plenary publication year: 2024	Next assessment: 2027
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Standardised daily single trawl CPUE index of abundance	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-The relationship between SNA 2N and Bay of Plenty snapper is uncertain. Recreational harvest estimates (and therefore estimates of relative exloitation) are only are only available for 3 years, 2012, 2018 and 2023.	

Qualifying Comments
Recreational harvest was 19% of removals in 2023 but the full recreational catch history is not known. The boundary between the SNA 2S and SNA 2N stocks is uncertain.

Fisheries Interactions
Snapper is principally a bycatch of the tarakihi bottom trawl fishery in SNA 2N.

- **SNA 2S**

Stock Status		
Most Recent Assessment Plenary Publication Year	2024	
Catch in most recent year of assessment	Year: 2022–23	Catch: 245 t (165 t commercial, 80 t recreational)
Assessment Runs Presented	Standardised combined CPUE (positive + binomial) model based on event level SNA, TRE, GUR, and TAR target single trawl data up to 2022–23 (Hawke Bay only)	
Reference Points	Target: B_{MSY} proxy (40% B_0) interpreted as twice the geometric mean standardised CPUE from the event resolution model for the period 2008–2012 Soft Limit: geometric mean standardised CPUE in the period 2008–2012 Hard Limit: 50% of the soft limit Overfishing threshold: Half the relative exploitation rate in 2008–2012	
Status in relation to Target	Very Likely (> 90%) to be at or above the target in 2022–23	
Status in relation to Limits	Soft Limit: Very Unlikely (< 10%) to be below Hard Limit: Very Unlikely (< 10%) to be below	
Status in relation to Overfishing	About as Likely as Not (40–60%) that overfishing is occurring.	

Historical Stock Status Trajectory and Current Status

(a) Annual commercial (gray) and total (black) removals for SNA 2S; (b) the standardised event resolution catch per unit effort (CPUE) index (black line), relative to the agreed reference points, for SNA 2S from trawling targeting gurnard, snapper, tarakihi and trevally, and (c) relative exploitation rate . The reference period is indicated by blue vertical dashed lines. Only one exploitation rate value falls within that period. The BT.MIX event index is used to define stock status and is plotted in black in panel (b); the longer BT.MIX day resolution standardised CPUE index is shown in grey.

Fisheries and Stock Trends	
Recent Trend in Biomass or Proxy	The standardised CPUE index was relatively stable from 2010 to 2016 then roughly doubled by 2021, and roughly doubled again by 2023.
Recent Trend in Fishing Mortality or Proxy	The relative exploitation rate decreased between 2018 and 2023
Other Abundance Indices	- Unstandardised recreational CPUE from 2015 to 2019 increased 2.5 times and has fluctuated without trend to 2023.
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Unlikely (<40%) at current catch Unknown for current TACC
Probability of Current Catch or TACC causing overfishing to continue or to commence	Unknown

Assessment Methodology	
Assessment Type	Level 2 – Partial Quantitative Stock Assessment
Assessment Method	Standardised CPUE

Assessment Dates	Latest assessment Plenary publication year: 2024	Next assessment: 2027
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Standardised single trawl CPUE index of abundance	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- Recreational harvest was 33% of removals in 2023 but the full recreational catch history is not known. - Overfishing threshold is based on a single observation. - Recreational harvest estimates (and therefore estimates of relative exloitation) are only are only available for 3 years, 2012, 2018 and 2023.	

Qualifying Comments
The Wairoa Hard, which is understood to be a snapper nursery ground in Hawke Bay, was impacted by land-derived sediments as a result of Cyclone Gabrielle in February 2023. Impacts on snapper recruitment are unknown.

Fisheries Interactions
Snapper is principally a bycatch of the red gurnard bottom trawl fishery in SNA 2S. Anecdotal feedback from fishers indicates that the operation of this fishery is constrained by the SNA 2 TACC.

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