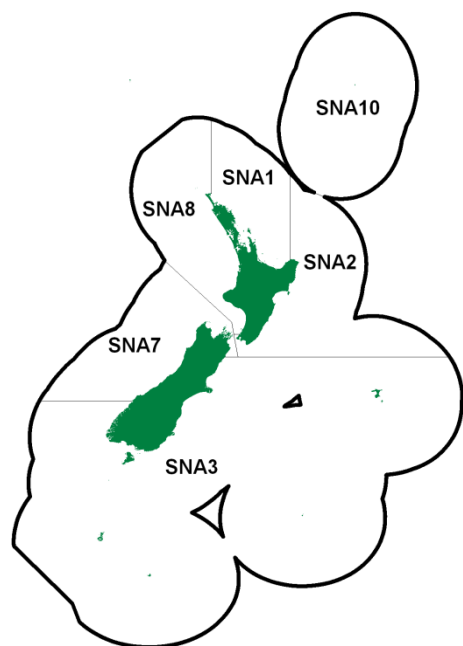


INTRODUCTION – SNAPPER (SNA)

(*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 FMAs	SNA 1		SNA 2		SNA 3		SNA 7		SNA 8	
	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

SNAPPER (SNA) – May 2025

Table 2 [Continued]:

Fishstock FMAs	SNA 1		SNA 2		SNA 3		SNA 7		SNA 8	
	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
2023–24	4 534	4 500	401	315	< 1	32	475	450	1 808	1 600

Fishstock QMAs	SNA 10		Total	
	10			
	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
2023–24	0	10	7 219	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.

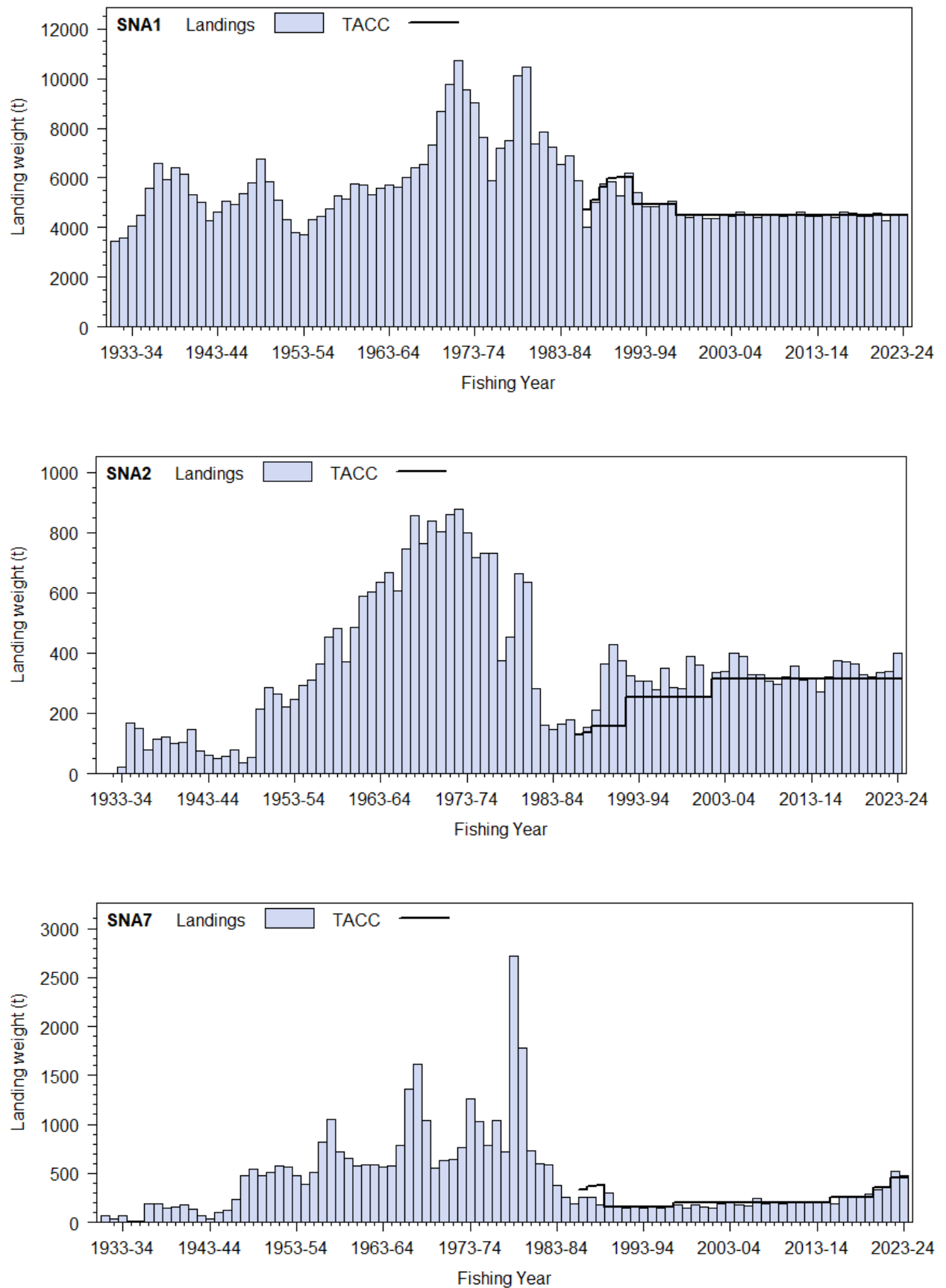


Figure 1: Total reported landings and TACCs for the four main SNA stocks. SNA 1 (Central East). [Continued on next page]

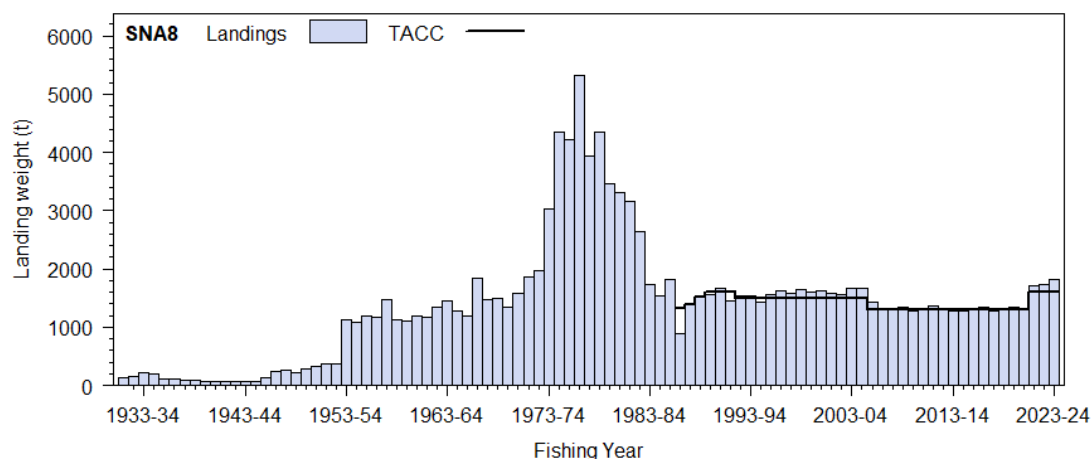


Figure 1 [Continued]: Total reported landings and TACC for the four main SNA stocks. SNA 2 (Central East) and SNA 7 (Challenger) and SNA 8 (Central Egmont).

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 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. The TACC was increased to 409 t in 2024–25. 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, in 2022–23 to 450 t and in 2024–25 to 720 t. From 1 October 2005 the TACC for SNA 8 was reduced to 1300 t within a TAC of 1785 t, and increased in 2021–22 to 1600 t and 2240 t in 2024–25 following a rebuild of the stock. Table 3 shows the TACs, TACCs, and allowances for each Fishstock. All commercial fisheries have a minimum legal size (MLS) for snapper of 25 cm.

Table 3: Recreational and Customary non-commercial allowances, other mortality, TACCs, and TACs (t) for snapper by Fishstock from 1 October 2024.

Fishstock	Recreational allowance	Customary non-commercial allowance	Other sources of mortality	TACC	TAC
SNA 1	3 050	50	450	4 500	8 050
SNA 2	122	14	40	409	585
SNA 3*	–	–	–	32	–
SNA 7	275	60	61	720	1 116
SNA 8	1 205	100	224	2 240	3 769
SNA 10*	–	–	–	10	–

* allowances and TAC not set

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. [Continued on next page].

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

Table 4 [Continued]:

Year	(a) Trawl	Trawl catch (all species)	Total snapper trawl catch	SNA 1	SNA 7	SNA 8
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

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.

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
<u>SNA 1</u>						
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	– ^s	1 669	–
Hauraki Gulf	2001	Telephone/diary	4 225	– ^s	3 507	–
Bay of Plenty	2001	Telephone/diary	1 791	– ^s	1 562	–
Total	2001	Telephone/diary	7 462	– ^s	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
<u>SNA 2</u>						
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	– ^s	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

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
<u>SNA 7</u>						
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
<u>SNA 8</u>						
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).

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 2024). 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 (Maggs et al 2024). 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, followed by a period of greater recreational harvest in 2016–17 and 2017–18, a reduction in harvest in 2019–20, but increasing after this.

Table 6a: Recreational snapper harvest estimates in tonnes (CV in parentheses) calculated by scaling the indices of relative catch to the geometric mean of the aerial-access estimates (2004–05, 2011–12, 2017–18) and National Panel Survey estimates (2022–23) in concurrent years for the East Northland, Hauraki Gulf and Bay of Plenty region of SNA 1 (Maggs et al 2024).

Year	East Northland	CV	Hauraki Gulf	CV	Bay of Plenty	CV	Total SNA 1	CV
2004–05	576	0.12	1 515	0.09	453	0.08	2 543	0.06
2006–07	–	–	1 488	0.13	–	–	–	–
2011–12	628	0.10	3 399	0.08	550	0.10	4 577	0.06
2012–13	499	0.10	1 708	0.09	256	0.16	2 464	0.07
2013–14	402	0.11	815	0.12	190	0.18	1 408	0.08
2014–15	388	0.12	692	0.10	196	0.23	1 275	0.08
2015–16	480	0.12	601	0.14	145	0.17	1 226	0.09
2016–17	522	0.11	582	0.12	297	0.18	1 402	0.07
2017–18	649	0.12	1 361	0.07	628	0.09	2 639	0.05
2018–19	720	0.09	1 457	0.10	298	0.13	2 474	0.07
2019–20	429	0.13	778	0.08	241	0.13	1 449	0.06
2020–21	626	0.14	667	0.08	451	0.14	1 744	0.07
2021–22	530	0.13	795	0.10	468	0.13	1 793	0.07
2022–23	510	0.13	713	0.08	574	0.11	1 797	0.06

1.2.2.2 SNA 2

National Panel Survey harvest estimates are available for SNA 2 from 2011–12, 2017–18 and 2022–23. 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 6b: Snapper harvest estimates in tonnes calculated by scaling the indices of relative catch to the geometric mean of the National Panel Survey estimates (2017–18 and 2022–23) in concurrent years for SNA 2 (Maggs et al 2024).

Year	Harvest (t)	CV
2014–15	49	0.21
2015–16	65	0.22
2016–17	68	0.27
2017–18	110	0.20
2018–19	160	0.18
2019–20	94	0.23
2020–21	130	0.25
2021–22	49	0.39
2022–23	97	0.21

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.

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 $M = 0.06 \text{ yr}^{-1}$ 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
<u>1. Instantaneous rate of natural mortality (<i>M</i>)</u>				
SNA 1, 2, 7, & 8	0.075			Hilborn & Starr (unpub. analysis)
<u>2. Weight = <i>a</i>(length)^{<i>b</i>} (Weight in g, length in cm fork length)</u>				
All	<i>a</i> = 0.04467	<i>b</i> = 2.793		Paul (1976)
<u>3. von Bertalanffy growth parameters</u>				
	<u>Both sexes combined</u>			
	<i>K</i>	<i>t</i> ₀	<i>L</i> _∞	
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)
<u>4. Age at recruitment (years)</u>				
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.				

* 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

The figures and tables in this section were updated and additional text included for the May 2025 Fishery Assessment Plenary. This summary is from the perspective of the snapper fishery; a more detailed summary from an issue-by-issue perspective is available in the Aquatic Environment and Biodiversity Annual Review where the consequences are also discussed ([Aquatic environment and biodiversity annual review \(AEBAR\) | NZ Government \(mpi.govt.nz\)](#)).

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 Non-target fish and invertebrate catch

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 2022–23, 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://protectedspeciescaptures.nz/PSCv9/released/>) 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 2.5% of hooks set (<https://protectedspeciescaptures.nz/PSCv9/released/>).

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 twenty two observed captures of seabirds (3 flesh-footed shearwater, 6 black petrel, 6 shearwaters that were not identified further, and 4 common diving petrel, 1 New Zealand white-faced storm petrel, 1 Australasian gannet and an unidentified small seabird) and 29 observed deck strikes (12 common diving petrels, 10 grey-faced petrel, 2 Buller’s shearwater, 1 flesh-footed shearwater, 1 cape petrel, 1 black petrel, 1 New Zealand white-faced storm 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. (<https://protectedspeciescaptures.nz/PSCv9/released/>)

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 2022–23, there were 230 observed captures of birds in snapper bottom longline fisheries (Table 9). The rate of capture varied between 0.0 and 7.2 birds per 1000 hooks observed, fluctuating without obvious trend. Seabirds observed captured in snapper longline fisheries were mostly flesh-footed shearwater (59%) and black (Parkinson’s) petrel (19%), and the majority were taken in the Northland-Hauraki area (74%) (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: Effort, observed, and estimated seabird captures by fishing year for the snapper bottom longline fishery. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); the capture rate (captures per thousand hooks); and the mean number of estimated total captures (with 95% confidence interval). Estimates are based on methods described by Abraham & Berkenbusch (2019).

Fishing year	Fishing effort			Observed captures		Estimated captures	
	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–03	13 726 712	0	0.0	0		831	573–1 191
2003–04	12 266 397	187 282	1.5	10	0.05	704	492–988
2004–05	11 546 041	244 692	2.1	13	0.05	602	423–832
2005–06	11 696 613	116 288	1.0	12	0.10	494	353–683
2006–07	10 350 791	62 360	0.6	0	0.00	463	331–634
2007–08	9 048 097	0	0.0	0		410	291–555
2008–09	8 981 142	318 274	3.5	25	0.08	424	312–564
2009–10	11 040 555	634 145	5.7	31	0.05	465	340–619
2010–11	11 343 552	0	0.0	0		492	359–658
2011–12	11 037 136	0	0.0	0		430	313–575
2012–13	10 501 460	237 670	2.3	2	0.01	422	305–565
2013–14	11 122 764	747 597	6.7	47	0.06	425	320–556
2014–15	10 846 672	0	0.0	0		359	255–488
2015–16	10 614 551	337 125	3.2	7	0.02	352	252–476
2016–17	10 757 966	486 700	4.5	4	0.01	344	247–471
2017–18	10 426 907	327 091	3.1	14	0.04	339	243–460
2018–19	10 808 816	270 309	2.5	3	0.01	382	274–518
2019–20	11 079 573	800 927	7.2	15	0.02	392	277–535
2020–21	11 356 824	503 100	4.4	35	0.07	437	313–595
2021–22	9 356 020	349 500	3.7	6	0.02	302	205–427
2022–23	9 817 203	60 450	0.6	6	0.10	343	227–500

Table 10: Number of observed seabird captures in snapper bottom longline fisheries, 2002–03 to 2022–23, by taxon and area. The risk category is an estimate of aggregate potential fatalities for trawl and longline fisheries relative to the Population Sustainability Threshold, PST (an analogue of the PBR approach) (Edwards et al 2023). The current version of the risk assessment does not include recovery factor.

Taxa	Risk category	Northland and Hauraki	Bay of Plenty	West Coast North Island	Taranaki	Total
Black petrel	High	41	2			43
Flesh-footed shearwater	Medium	85	43		7	135
Northern giant petrel	Low	1				1
Pied shag	Negligible	2				2
Fluttering shearwater	Negligible	8	1			9
Sooty shearwater	Negligible	2				2
Australasian gannet	Negligible	2				2
Buller's shearwater	Negligible	12		1		13
Southern black-backed gull	Negligible	5				5
Cape petrel	NA				1	1
Common diving petrel	Negligible	1				1
Fulmars, petrels, prions and shearwaters	NA	9				9
Grey petrel	Negligible		1			1
Little penguin	Negligible	1				1
Red-billed gull	NA	1	4			5
Total birds	–	170	51	1	8	230

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 0.14 and 0.13 of risk, respectively (Table 11). The black petrel is assessed at high risk from commercial fishing in New Zealand waters, and the flesh-footed shearwater is assessed at medium risk from commercial fishing in New Zealand waters (Edwards et al 2023).

Table 11: Risk ratio of seabirds predicted by the SEFRA for the snapper target bottom longline fishery and all fisheries included in the SEFRA, 2006–07 to 2019–20, with a risk posed by the domestic tuna and swordfish SLL fishery. The risk ratio is an estimate of aggregate potential fatalities across trawl and longline fisheries relative to the Population Sustainability Threshold, PST (an analogue of the PBR approach) (Edwards et al 2023). The current version of the risk assessment does not include a recovery factor. The New Zealand threat classifications are shown (Robertson et al 2021).

Species name	Risk ratio			Risk category	NZ Threat Classification
	Snapper BLL	Total risk from NZ commercial fishing	% of total risk from NZ commercial fishing		
Black petrel	0.14	0.49	29.0	High	Threatened: Nationally vulnerable
Flesh-footed shearwater	0.13	0.22	57.8	Medium	At Risk: Relict

4.3.3 Sea turtle captures

Between 2002–03 and 2022–23 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 7 white pointer shark individuals in snapper trawls between 2012–13 and 2023–24, 4 of which were dead upon capture, the remainder were released alive. Little is known about the survival of released individuals, but it is assumed to be low. Over the same period fishers have reported catching 40 white pointer shark individuals in snapper bottom longline, 6 of which were dead upon capture.

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 km². This has mostly (67%) been within SNA 1, where annual aggregate area fished declined from around 3000 km² (2007–08 to 2012–13) to 2100 km² (2016–17), before increasing to around 3000 km² (2017–18 and 2020–21). Annual area fished within SNA 2 and SNA 7 has fluctuated around 350 km²; whereas in SNA 8, the annual area fished declined from 1300 km² in 2007–08 to 480 km² 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, Hermesen 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

Fisheries New Zealand have developed guidelines on the identification of habitats of particular significance for fisheries management ([Habitats of particular significance for fisheries management | NZ Government](#)), and is in the process of reviewing available evidence for the development of an online register of habitats. 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) – May 2025

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