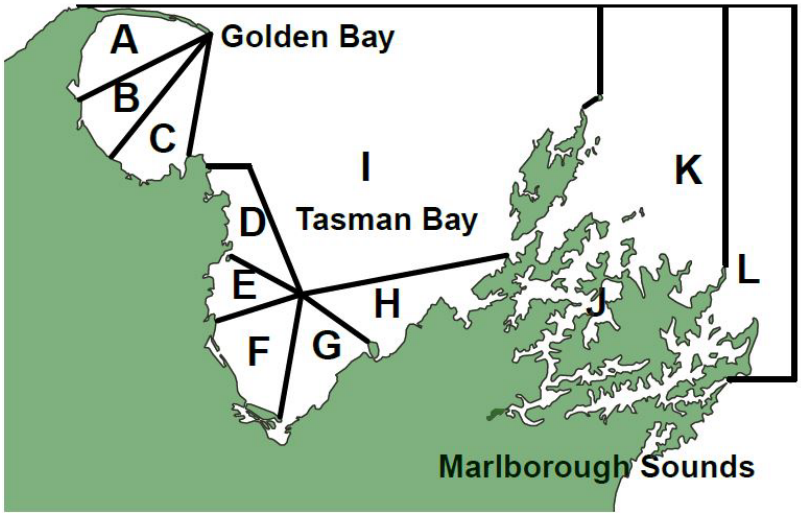
SCALLOPS Nelson/Marlborough (SCA 7)

(*Pecten novaezelandiae*)
Kuakua, Tipa



1. FISHERY SUMMARY

The Nelson/Marlborough scallop fishery (SCA 7), often referred to as the 'Southern' or 'Challenger' scallop fishery, comprises 12 sectors (statistical reporting areas 7AA to 7LL, labelled as A–L in the map above) spread across three regions: Golden Bay, Tasman Bay, and the Marlborough Sounds. SCA 7 was introduced into a modified form of the Quota Management System (QMS) in 1992, and in 1995 an annual Total Allowable Commercial Catch (TACC) was set at 720 t meatweight. In 2002 the TACC was increased to 747 t and a Total Allowable Catch (TAC) set with allowances made for customary and recreational fishing. In 2014 the TACC was decreased to 400 t and an allowance of 40 t for other sources of mortality was set within the TAC (Table 1).

Table 1: Total Allowable Catch (TAC, t), customary, recreational, and other sources of mortality allowances (t), and TACC (t) declared for SCA 7 since introduction into the QMS in 1992.

Year	TAC	Customary	Recreational	Other mortality	TACC
1995–2001	–	–	–	–	720
2002–2013	827	40	40	0	747
2014–present	520	40	40	40	400

Due to sustainability concerns, a temporary partial area closure for the taking and possession of scallops by both recreational and commercial fishers in Marlborough Sounds and part of Tasman Bay (sector 7HH) was implemented for the 2016–17 scallop season (15 July 2016 to 14 February 2017) (Ministry for Primary Industries 2016). The closure was extended for the 2017–18 scallop season and expanded to cover all areas within SCA 7 and Port Underwood (Ministry for Primary Industries 2017). The closure has since continued and will remain in place until an opening regime has been developed and implemented.

In 2018 Fisheries New Zealand established a multisector group, the Southern Scallop Working Group (SSWG), to work on an agreed view of when the number of scallops has increased sufficiently to allow harvesting, and the rules that will be necessary to ensure that any harvest is sustainable. The immediate priority was for the SSWG to develop a strategy that sets out overarching objectives to improve the management of the Marlborough Sounds scallop fishery, and the ecosystem that supports it. In 2020, the Minister of Fisheries approved the resulting 'Southern Scallop Strategy: Marlborough Sounds' as a Fisheries Plan under section 11A of the Fisheries Act 1996, which gives the strategy

formal status under legislation. Following the approval of the Strategy by the Minister, the SSWG developed and finalised the Implementation Plan in April 2021 (Fisheries New Zealand 2021). As the Marlborough Sounds strategy is implemented, the focus of the SSWG will shift to developing a strategy for managing and restoring the Golden Bay and Tasman Bay (including Croisilles Harbour) scallop fisheries.

1.1 Commercial fisheries

Up to 1980, the commercial fishery was managed with a combination of gear restrictions, closed areas and seasons, and a 100-mm size limit, together with limitations on the number of entrants (from 1977). Landings reached an all-time peak of 1244 t in 1975, when there were 216 licensed vessels involved in the fishery. The fishery then rapidly declined, and in 1981 and 1982 the fishery was closed. Only 48 licences were issued when it re-opened in 1983, with each vessel being allocated a defined, and equal, catch limit on an annual basis. A scallop enhancement programme was initiated in the same year. By 1989 the success of the enhancement programme enabled rotational fishing in Golden and Tasman bays (sectors A–I). Under the rotational fishing strategy, several sectors were opened to fishing each year and were re-seeded following fishing down. Rotational fishing was accompanied by a reduction in the minimum legal size to 90 mm.

In 1992 when SCA 7 was introduced into the QMS an annual harvest limit of 640 t (12 t to each of the 48 licence holders, plus 64 t to Māori) was initially allocated as Individual Transferrable Quota. Provision was also made for any additional quota in excess of the 640 t to be allocated to the Crown for lease, with preference being given to existing quota holders.

Most of the management responsibilities for the fishery were transferred from government to industry in 1994 when the quota owners established the Challenger Scallop Enhancement Company Ltd. (CSEC) as the formal entity to self-govern the fishery subject to conditions agreed with the government. Key documents associated with CSEC self-governance of the fishery include a Memorandum of Understanding agreement (Ministry of Fisheries & CSEC 1998) and fisheries plans (CSEC 1998, 2005).

In October 1995, legislation was passed in which annual quotas were determined as a fixed proportion of the TACC rather than being allocated as a fixed tonnage. This provided for greater flexibility in changing the TACC. A statutory Enhancement Plan was also introduced at this time, to provide for ongoing enhancement with rotational fishing of the fishery. The legislation was modified to enable a transition towards the enhancement programme being implemented by the CSEC rather than the Ministry of Fisheries. In 1996, because of the rotational fishing and stock enhancement management strategy being used to manage the stocks in SCA 7, the fishery was placed on the Third Schedule to the Fisheries Act 1996 and was, therefore, able to have an alternative TAC set under s14 of the Act.

A simulation modelling study of the SCA 7 scallop fishery examined the effects of catch limits, exploitation rate limits, rotational fishing, and enhancement (Breen & Kendrick 1997). The results suggested that constant catch strategies are risky, but constant exploitation rate strategies are close to optimal if the maximum rate is appropriate. Rotational fishing appeared to be highly stabilising, even without enhancement. Collapses occurred only when short rotation periods were combined with high fishing intensity. Three-year rotation appeared to be safer than two-year rotation. Enhancement appeared to improve safety, catch, and biomass and slightly reduced the population variability. The conclusions from this study underpinned the agreed rotational and enhancement management framework for the fishery. However, the theory of rotational fishing assumes that scallops, and habitats important for scallops, are distributed approximately evenly among the areas (sectors) to be fished rotationally. This is probably an invalid assumption for the SCA 7 fishery sectors.

Over time the rotational fishing and stock enhancement management strategy changed considerably. Rotational harvesting was formally implemented in the 1989–90 fishing year. For six years from 1989–90 to 1994–95, rotational fishing was almost entirely carried out at the sector level. In the next three years from 1995–96 to 1997–98 the sector level rotation began to break down (some fishing

occurred in areas that would have been closed under sector-level rotation). From 1998–99 onwards, especially in Golden Bay, sector level rotation did not occur, and parts of sectors were able to be fished wherever scallops were available. In addition, reseeding activity was significantly reduced. Annual dredge surveys, which estimate biomass levels and population size structure for each sector, were conducted before each season began. This approach enabled the fishery to concentrate in areas where scallops were predominantly above the minimum legal size and reduced disturbance in areas where most of the population is sub-legal. Following the closure, the dredge surveys carried on until 2021 to inform the Minister regarding the status of the stock.

All commercial fishing is by dredge, with fishers using 'ring-bag' dredges rather than the 'box' dredge designs used in the northern (Coromandel and Northland) fisheries. Vessels in the SCA 7 fishery tow one or two ring-bag dredges up to 2.4 m in width with heavy tickler chains over approximately 1 mile (there are no teeth or tines on the leading bottom edge of the dredges in the SCA 7 fishery, unlike those of the fixed tooth bars used on dredges in the northern fisheries).

Reported landings (in meatweight; i.e., processed weight, being the adductor muscle and attached roe only) and TACC changes from the SCA 7 scallop fishery are shown in Figure 1 and listed in Table 2 and Table 3. The fishing year applicable to this fishery is from 1 April to 31 March. Commercial fishing in the last years before the fishery closed has usually occurred between September and November, although opening and closing dates are defined each year and may differ between years.

Scallop meatweight recovery (meatweight divided by greenweight) is variable among areas, years, and weeks within the fishing season but in general appears to be highest from scallops in parts of Golden Bay (e.g., sector A) and lowest from those in Tasman Bay (e.g., sector D). Using data on the commercial landings of recruited scallops in the period 1996–2008, the mean annual meatweight recovery was 13.8% for Golden Bay, 11.8% for Tasman Bay, and 13.2% for the Marlborough Sounds. An analysis of meatweight recovery data at the time of the survey and during the fishing season for the years 1996–2007 showed meatweight recovery measured at the time of the survey could not be used to predict meatweight recovery during the fishing season.

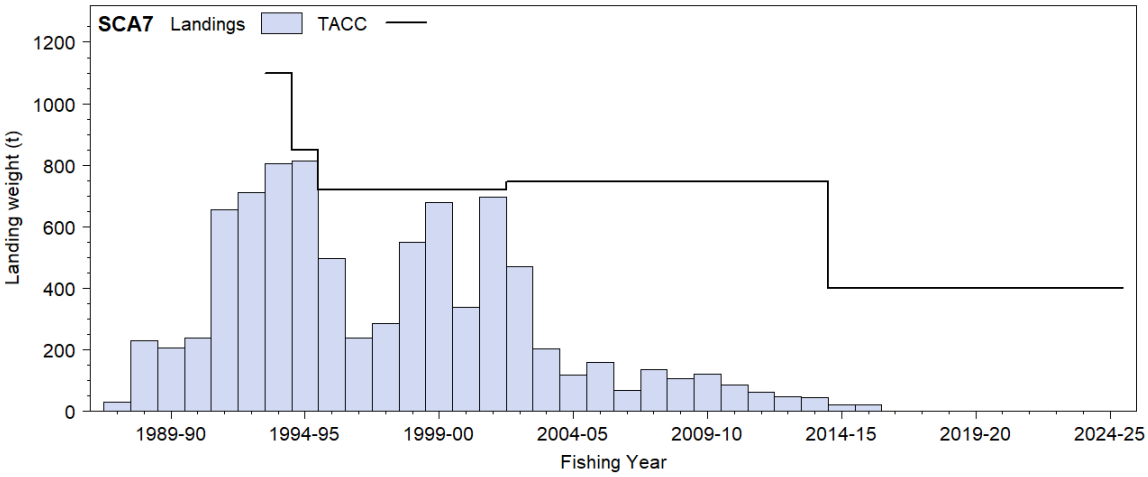


Figure 1: Historical landings and TACC (t, meatweight) for SCA 7 (Nelson/Marlborough). The fishery has been closed since 2016.

Table 2: Reported landings (t, meatweight) of scallops from SCA 7 from 1959–60 to 1982–83. The fishery was closed for the 1981–82 and 1982–83 scallop fishing years. Landings are presented by region (GB, Golden Bay; TB, Tasman Bay; MS, Marlborough Sounds) and total, except before 1977 when landings were reported by the Golden Bay and Tasman Bay combined area (Gold/Tas) (King & McKoy 1984).

Year	Gold/Tas	GB	TB	MS	Total
1959–60	1	–	–	0	1
1960–61	4	–	–	2	7
1961–62	19	–	–	0	19
1962–63	24	–	–	< 0.01	24
1963–64	105	–	–	2	107
1964–65	108	–	–	2	110
1965–66	44	–	–	< 0.5	44
1966–67	23	–	–	8	32
1967–68	16	–	–	7	23
1968–69	1	–	–	8	9
1969–70	72	–	–	6	78
1970–71	73	–	–	7	80
1971–72	206	–	–	10	215
1972–73	190	–	–	46	236
1973–74	193	–	–	127	320
1974–75	597	–	–	36	632
1975–76	1 172	–	–	73	1 244
1976–77	589	–	–	79	668
1977–78	–	342	168	63	574
1978–79	–	86	4	76	166
1979–80	–	32	30	40	101
1980–81	–	0	14	27	41
1981–82	–	–	–	–	–
1982–83	–	–	–	–	–

1.2 Recreational fisheries

Historically CSEC consulted with recreational fishers (and environmental interests) on the results of the annual biomass survey and the CSEC harvest proposals (including commercial closed areas) to seek agreement prior to submitting the Harvest Plan to the Minister. In recent years, before the fishery closure, agreement was not achieved. Estimates of annual recreational scallop harvest from SCA 7 are shown in Table 4. The harvest estimates provided by telephone-diary surveys between 1993 and 2001 are no longer considered reliable for various reasons. A Recreational Technical Working Group concluded that these harvest estimates should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a methodological error; and c) the 2000 and 2001 estimates are implausibly high for many important fisheries. In response to these problems and the cost and scale challenges associated with onsite methods, a national panel survey was conducted for the first time throughout 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 harvest information was collected in 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) although the fishery in SCA 7 was closed. A creel survey was conducted in 2003–04 (Cole et al. 2006). The annual recreational harvest level is likely to vary substantially through time.

For further information on recreational fisheries refer to section 1.2 of the Introduction – Scallops chapter.

Table 3: Catch limits and reported landings (t, meatweight) of scallops from SCA 7 since 1983–84. The fishery was closed for the 1981–82 and 1982–83 scallop fishing years and was subsequently managed under a rotationally enhanced regime. The fishery was closed in 2016. Two catch limits are presented: TACC, Total Allowable Commercial Catch; MSCL, Marlborough Sounds catch limit (a subset of the TACC, or a subset of the Annual Allowable Catch in 1994–95). Landings data come from the following sources: FSU, Fisheries Statistics Unit; MHR, Monthly Harvest Returns (Quota Harvest Returns before October 2001); CELR, Catch Effort Landing Returns; CSEC, Challenger Scallop Enhancement Company. Landings are also presented by region (GB, Golden Bay; TB, Tasman Bay; MS, Marlborough Sounds) and best total (believed to be the most accurate record) for the SCA 7 Fishstock. – indicates no data.

	Catch limits		Landings				Landings by region and best total				
Year	TACC	MSCL	FSU	MHR	CELR	CSEC	GB	TB	MS	Best total	Source
1983–84	–	–	225	–	–	–	< 0.5	164	61	225	FSU
1984–85	–	–	367	–	–	–	45	184	138	367	FSU
1985–86	–	–	245	–	–	–	43	102	100	245	FSU
1986–87	–	–	355	–	–	–	208	30	117	355	FSU
1987–88	–	–	219	29	–	–	113	1	105	219	FSU
1988–89	–	–	222	228	–	–	127	23	72	222	FSU
1989–90	–	–	–	205	125	–	68	42	95	205	CELR
1990–91	–	–	–	237	228	–	154	8	66	228	CELR
1991–92	–	–	–	655	659	–	629	9	20	659	CELR
1992–93	–	–	–	712	674	–	269	247	157	674	CELR
1993–94	*1 100	–	–	805	798	–	208	461	129	798	CELR
1994–95	*850	70	–	815	825	–	415	394	16	825	CELR
1995–96	720	73	–	496	479	–	319	92	67	479	CELR
1996–97	†720	61	–	238	224	231	123	47	61	231	CSEC
1997–98	†720	58	–	284	265	299	239	2	58	299	CSEC
1998–99	†720	120	–	549	511	548	353	78	117	548	CSEC
1999–00	720	50	–	678	644	676	514	155	7	676	CSEC
2000–01	720	50	–	338	343	338	303	19	16	338	CSEC
2001–02	720	76	–	697	715	717	660	32	25	717	CSEC
2002–03	747	–	–	469	469	471	370	39	62	471	CSEC
2003–04	747	–	–	202	209	206	28	107	71	206	CSEC
2004–05	747	–	–	117	112	118	20	47	51	118	CSEC
2005–06	747	–	–	158	156	156	35	5	116	157	CSEC
2006–07	747	106	–	67	66	68	26	0	43	68	CSEC
2007–08	747	–	–	134	183	134	128	0	6	134	CSEC
2008–09	747	–	–	103	137	104	76	0	28	104	CSEC
2009–10	747	123	–	120	120	–	19	0	101	120	CELR
2010–11	747	–	–	85	85	–	10	0	74	85	CELR
2011–12	747	–	–	62	61	–	1	0	60	61	CELR
2012–13	747	53	–	48	48	–	0	0	48	48	CELR
2013–14	747	48	–	43	44	43	0.2	0	43	43	CSEC
2014–15	400	30	–	22	22	22	0	0	22	22	CSEC
2015–16	400	23	–	22	22	22	0	0.8	21	22	CSEC
2016–17	400	closure	–	0	0	–	0	0	0	0	CELR
2017–18	400	closure	–	0	0	–	0	0	0	0	CELR
2018–19	400	closure	–	0	0	–	0	0	0	0	CELR
2019–20	400	closure	–	0	0	–	0	0	0	0	CELR
2020–21	400	closure	–	0	0	–	0	0	0	0	CELR
2021–22	400	closure	–	0	0	–	0	0	0	0	CELR
2022–23	400	closure	–	0	0	–	0	0	0	0	CELR
2023–24	400	closure	–	0	0	–	0	0	0	0	CELR
2024–25	400	closure	–	0	0	–	0	0	0	0	CELR

*Annual Allowable Catch (AAC); TACCs came into force 1 October 1995.

† Initial industry controlled catch limit was 350 t in 1996–97, 310 t in 1997–98, and 450 t in 1998–99.

Table 4: Estimates of the annual recreational harvest of scallops from SCA 7. Number, number of scallops; meat, meatweight (assuming 12.5% recovery of meatweight from greenweight). GB/TB, Golden Bay/Tasman Bay. The estimates provided by telephone-diary surveys are no longer considered reliable for various reasons. The 2011–12 estimate assumes a 12.5% recovery of meat from greenweight. The fishery has been closed since 2016.

Year	Area	Survey method	Number	CV	Meat (t)	Reference
1992–93	SCA 7	Telephone-diary	1 680 000	0.15	22	Teirney et al. (1997)
1996	SCA 7	Telephone-diary	1 456 000	0.21	19	Bradford (1998)
1999–00	SCA 7	Telephone-diary	3 391 000	0.20	44	Boyd & Reilly (2004)
2000–01	SCA 7	Telephone-diary	2 867 000	0.14	37	Boyd et al. (2004)
2003–04	GB/TB	Creel survey	860 000	0.05	9	Cole et al. (2006)
2011–12	SCA 7	Panel survey	796 164	0.23	11	Wynne-Jones et al. (2014)
2017–18	SCA 7	Panel survey	0	–	–	Wynne-Jones et al. (2019)
2022–23	SCA 7	Panel survey	0	–	–	Heinemann & Gray (2024)

1.3 Customary fisheries

The information on Māori customary harvest under the provisions made for customary fishing can be limited (Table 5). These numbers are likely to be an underestimate of customary harvest as only the catch approved and harvested in kilograms and numbers are reported in the table.

Table 5: Fisheries New Zealand records of customary harvest of scallops (reported as greenweight (kg) or numbers) taken from the Challenger scallop fishery for years for which harvest data is available. – indicates no data.

	Weight (kg)		Numbers	
Fishing year	Approved	Harvested	Approved	Harvested
2006–07	–	–	800	800
2007–08	600	600	17 500	15 830
2008–09	–	–	6 300	5 025
2009–10	–	–	31 150	28 560

For further information on customary fisheries refer to section 1.3 of the Introduction – Scallops chapter.

1.4 Unreported catch

For information on unreported catch refer to section 1.4 of the Introduction – Scallops chapter.

1.5 Other sources of mortality

Dredging has incidental effects on scallops and their habitats, but there has not been any specific research on the level of incidental mortality caused by ring-bag dredging in the SCA 7 fishery.

Incidental mortality of scallops may also result from bottom trawling, although the extent of this is unknown. Observational monitoring of *P. novaezelandiae* spat released in the first three years of enhancement (1984–86) in Golden Bay suggested that spat survival was higher in areas closed to trawling (Bradford-Grieve et al. 1994).

For further information on other sources of mortality refer to section 1.5 of the Introduction – Scallops chapter.

2. BIOLOGY

All references to ‘shell length’ in this chapter refer to the maximum linear dimension of the shell, in an anterior-posterior axis. Scallops in the outer Pelorus Sound grow to a shell length of about 60 mm in one year and can reach 100 mm in about two to three years (Table 6). This was typical of the pattern of growth that occurred under the initial rotational fishing strategy in Tasman Bay and Golden Bay as well. Growth slows during the winter and was found to vary between years (it is probably influenced by water temperature, food availability, and scallop density). Growth rings form on the shell during winter but also at other times, precluding the use of ring counts as accurate indicators of age. Experience with enhanced stocks in Tasman Bay and Golden Bay has indicated that scallops generally attain a shell length of 90 mm in just under two years although, in conditions where food is limited, almost three years may be required to reach this size.

From studies of the ratio of live to dead scallops and the breakdown of the shell hinge in dead scallops, Bull (1976) estimated the annual natural mortality rate for two populations of adult scallops in the Marlborough Sounds (Forsyth Bay and North West Bay in Pelorus Sound) to be 23% (M = 0.26) and 39% (M = 0.49). From a tagging study conducted in Golden Bay and Tasman Bay from 1991 to 1992, Bull & Drummond (1994) estimated the mortality of 0+ and 1+ scallops to be about 38% (M = 0.21) per year and the mortality of 2+ scallops to be 66% (M = 0.46). These studies suggest that average natural mortality in the SCA 7 fishery is quite high (Table 6), and most previous stock assessments have assumed $M = 0.5\ y^{-1}$ (instantaneous rate). Incidences of large-scale die-off in localised areas have been observed (e.g., mortality associated with storms in 1998).

Table 6: Estimates of biological parameters.

		Estimates	Source
1. Natural mortality, M		*M*	
Pelorus Sound		0.26, 0.49	Bull (1976)
Golden Bay & Tasman Bay		0+ & 1+, 0.21	Bull & Drummond (1994)
Golden Bay & Tasman Bay		2+, 0.46	Bull & Drummond (1994)
2. Growth			
Age-length relationship	Age (y)	SL (mm)	
Pelorus Sound	1	60	Bull (1976)
Pelorus Sound	2	97	Bull (1976)
Pelorus Sound	3	105	Bull (1976)
Pelorus Sound	4	111	Bull (1976)
von Bertalanffy parameters	L_∞	*K*	
	144	0.40	Data of Bull (1976), analysed by Breen (1995)

For further information on biology refer to section 2 of the Introduction – Scallops chapter.

3. STOCKS AND AREAS

Whether or not scallops in Tasman Bay and Golden Bay constituted a single genetic stock before enhancement began is unknown. Enhancement in the Marlborough Sounds has been limited but could have contributed towards homogenising stocks. Water movements eastward through Cook Strait could have enabled a degree of genetic mixing between Tasman Bay/Golden Bay and Marlborough Sounds before any enhancement began. It is currently assumed for management that the SCA 7 stock is made up of three individual sub-stocks (Golden Bay, Tasman Bay, and Marlborough Sounds) that are separate from the Northland and Coromandel stocks and from scallops in the various west coast harbours, Stewart Island, and Chatham Island areas.

For further information on stocks and areas refer to section 3 of the Introduction – Scallops chapter.

4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

In the Southern scallop stock (SCA 7), data on the non-target catch of the 1994–2020 surveys have been collected but not analysed, except for preliminary estimation of the 1998–2013 non-target catch trajectories (Williams et al. 2014).

Refer to section 4 of the Introduction – Scallops chapter for general information on environmental and ecosystem considerations.

5. STOCK ASSESSMENT

5.1 Estimates of fishery parameters and abundance

The status of the SCA 7 stock is assessed using data collected from fishery-independent dredge surveys (noting that a dive survey of scallops in non-commercial fishing areas in the Marlborough Sounds and Croisilles Harbour was also conducted in 2021). The survey data are analysed to estimate the spatial distribution, size structure, abundance, and biomass of the population of scallops within the area covered by the survey. Dredges are not 100% efficient at catching all scallops within the area of seabed swept by the dredge, making it necessary to apply dredge efficiency corrections to the raw survey data to obtain estimates of absolute abundance and biomass. Information on dredge efficiency, the proportion of the scallops in the path of the gear that are caught, has been generated from a dedicated study using paired sampling by divers and dredges (Figure 2, Tuck et al. 2018). Efficiency-corrected dredge survey estimates form the basis of SCA 7 science advice to fisheries management.

The first investigation of the scallop resource in SCA 7 was in Tasman Bay in 1959 (Choat 1960). Scallop surveys in the Nelson and Marlborough regions from 1960–93 were carried out by several workers, and the data were documented by Doonan et al. (1985) for the 1960–82 surveys, and, as stated by Bradford-Grieve et al. (1994), in unpublished MAF reports by Bull. Bradford-Grieve et al. (1994) also noted that an intensive study on scallop population dynamics (reproductive biology, larval, ecology, spat settlement, and adult growth and mortality) was carried out by MAF in the period 1982–86 using Croisilles Harbour as a base, but that work remains unpublished.

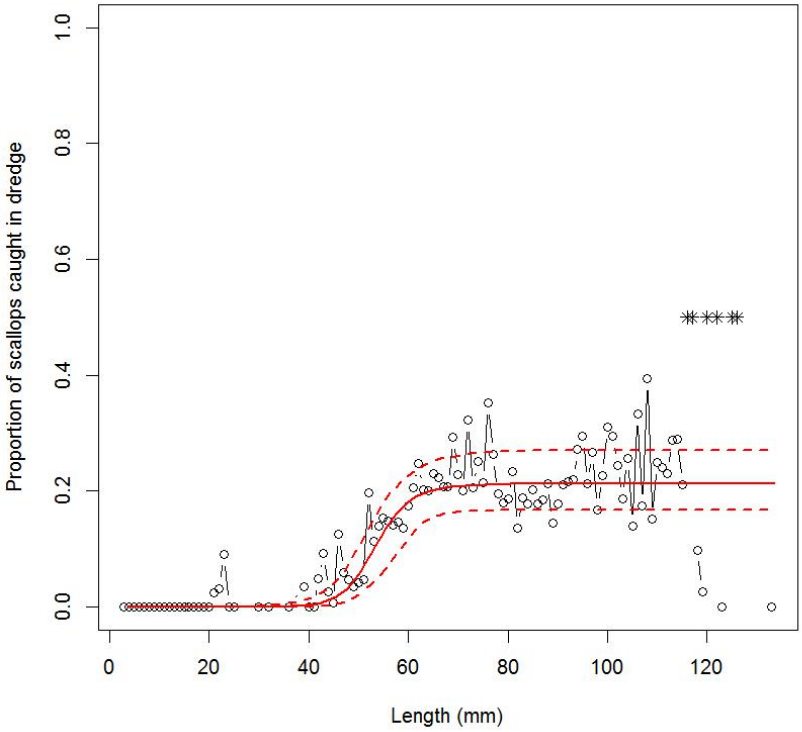


Figure 2: SCA 7 ring-bag dredge efficiency (from Tuck et al. 2018). The plotted curve is a logistic capped selectivity ogive (L50 = 53.3mm, a95=7.3mm, amax=0.21) fitted to the proportion of scallops retained in the dredge. Solid line is the fit to all data in the 2018 study and dashed lines represent 95% CI of selectivity at each length.

Surveys of scallops in the main commercial scallop beds in SCA 7 have been conducted annually since 1994 (except in 2016 when there was no survey due to the closure of the fishery that year), using stratified random sampling by dredging. The surveys are usually carried out in May but the surveys in 2017 (Williams et al. 2017) and 2018 (Williams et al. 2018) were conducted in January in time to inform fisheries management decisions required for the 1 April sustainability round. Two-phase sampling was used in surveys until 2008, and single-phase sampling was used in surveys from 2009. In 2013, 2018, 2019 (Williams et al. 2019) and 2021 (Williams et al. 2024), only the Marlborough Sounds sub-stock was surveyed; full surveys of Golden Bay and Tasman Bay were not conducted because of the expected low abundance of scallops in those bays (although some targeted sampling was conducted in May 2021 in Tasman Bay). In 2015 three surveys were conducted: a pre-fishing season survey in May (Williams et al. 2015a), an in-fishing season survey of key scallop beds in October (Williams et al. 2015b) and a post-fishing season survey in November (Williams et al. 2015c). The purpose of the November 2015 survey was to survey the accessible areas of the entire SCA 7 stock and not just survey those areas utilised by the commercial fishery, as is usually done in the pre-fishing season surveys. With the exception of the in-season and post-season surveys in 2015, surveys since 1998 are broadly comparable, in that they used the same fishing gear and covered similar areas in which the main scallop beds occurred. Earlier surveys covered smaller areas, although these may have included the main areas of recruited scallop densities.

The surveys show that scallops have been distributed in particular areas within the three regions of SCA 7 (Figure 3), although the densities observed in many areas have reduced dramatically over time (Williams et al. 2014). In Golden Bay, the highest densities of recruited scallops ('commercial size' scallops, 90 mm or larger) have been in waters between 10 and 20 m depths throughout the curvature of the bay and on a bank to the south of Farewell Spit, with moderate densities between 20 and 30 m depths, and lower densities in deeper water (although high densities of recruited scallops have been observed in 20–30 m depths in sectors B and C in 1994 and 1995 following enhancement of those areas in 1992 and 1993). Similarly, recruited densities in Tasman Bay have been found mainly in depths between 10 and 25 m, particularly in the western half of the bay, plus in a small area within Croisilles Harbour. Recruited scallops have been distributed in many of the different bays and inlets in the Marlborough Sounds.

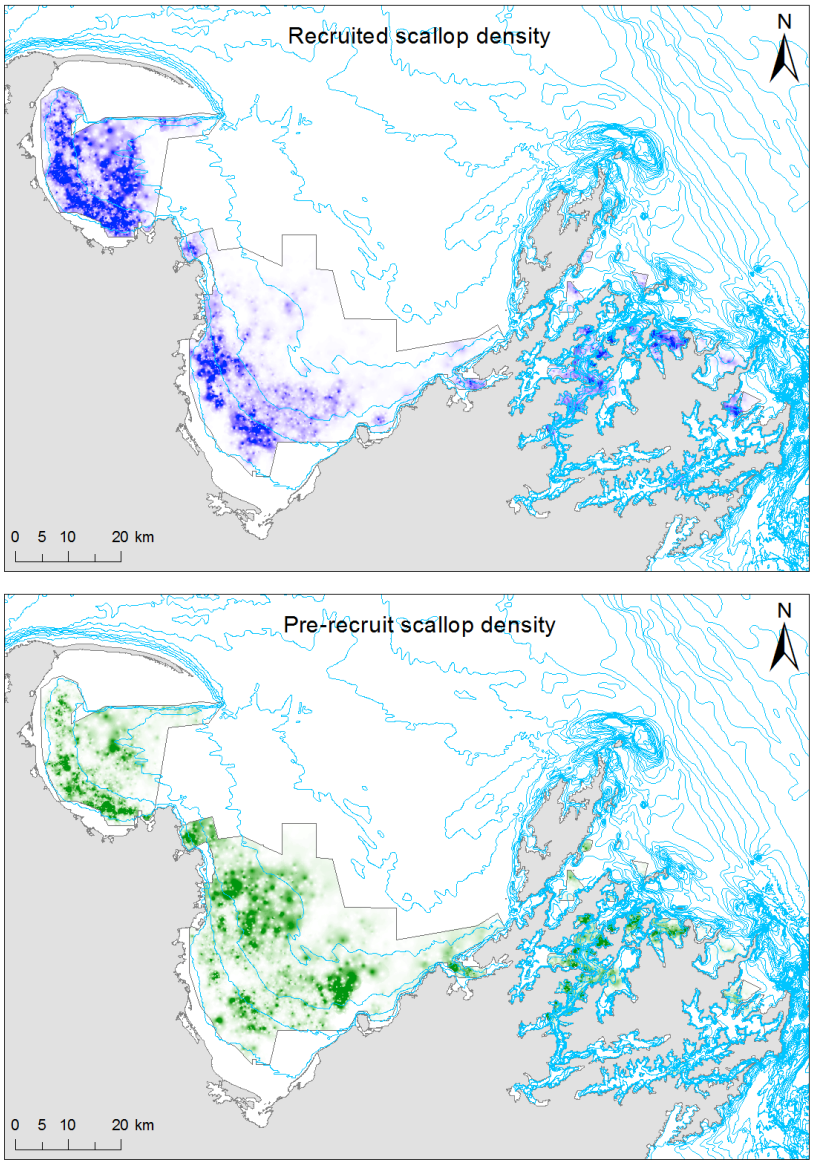


Figure 3: Spatial density of recruited (top) and pre-recruit (bottom) scallops in SCA 7 from an inverse density weighted (IDW) interpolation of SCA 7 survey estimates to 2011. Depth contours at 10 m intervals are shown overlaid for reference. Source: Williams et al. (2014).

In the most recent dredge surveys of SCA 7 in May 2020 (Williams et al. 2021) and of Marlborough Sounds in 2021 (Williams et al. 2024), the highest catches of recruited scallops were mainly from tows in key strata in the Marlborough Sounds, located mainly in the outer Pelorus Sound region and in Queen Charlotte Sound (Figure 4). Catches in Golden Bay and Tasman Bay in 2020 were generally very low, except for a single tow in Tasman Bay sector 7G which had an unexpectedly high catch of

recruited scallops (Figure 4), plus horse mussels *Atrina zelandica*. The May 2020 dredge survey and subsequent June 2020 and June 2021 Tow-Cam video surveying by NIWA (unpublished data) provided evidence of a bed of scallops and horse mussels in 25–35 m water depth to the northwest of The Glen in Tasman Bay.

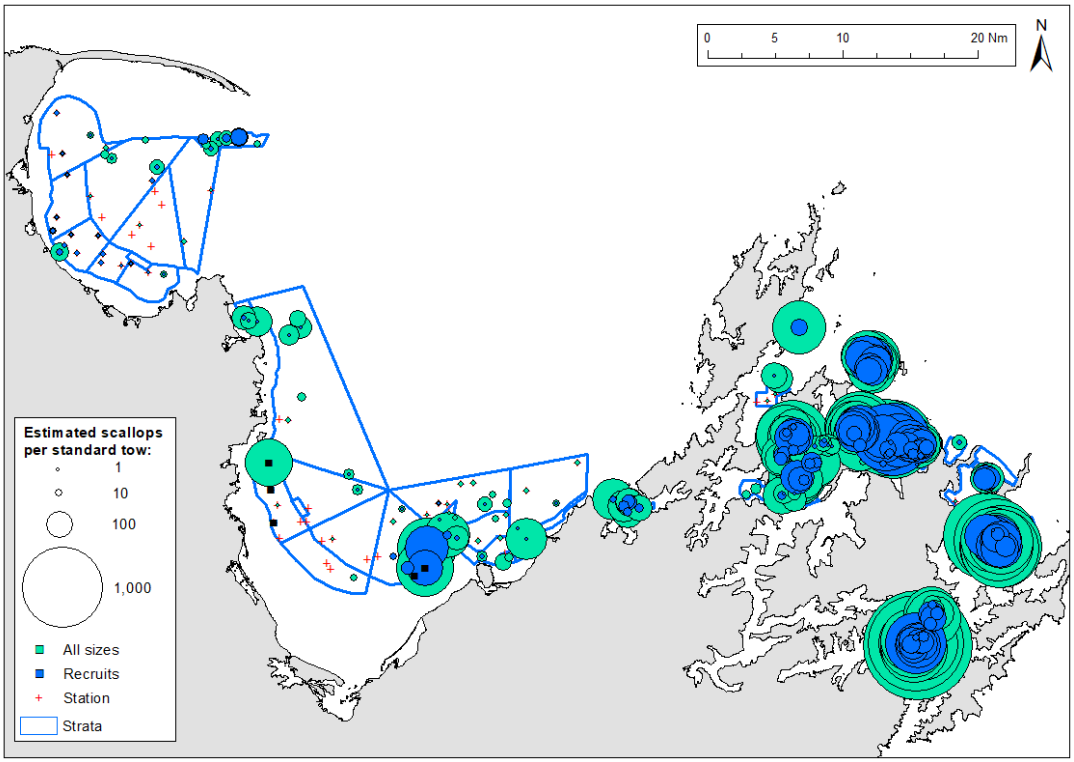


Figure 4: Catch per standard tow at the time of the SCA 7 survey (May 2020). Circle area is proportional to the number of scallops caught per standard distance towed (0.4 nautical miles), uncorrected for dredge efficiency. Dark blue shaded circles denote scallops of commercial recruited size (90 mm or larger), green shaded circles denote scallops of any size, crosses denote stratified random tow positions, black squares denote five exploratory non-random tow positions. Polygons denote survey strata boundaries. Catch per tow at the time of survey in Marlborough Sounds in May 2021 (Williams et al. 2024) was similar to that in 2020 shown here.

Surveys up to 1995 used the 'MAF' dredge, whereas from 1997 the 'CSEC' dredge was used. In 1996, both dredges were used, with data from the CSEC dredge being used for the biomass analysis. Analysis of the survey data involves applying estimates of dredge efficiency to produce absolute population estimates at the time of the surveys (May–June) and at the nominal start of the fishing season (September). The analysis uses a resampling with replacement analytical procedure to better account for uncertainty in the estimates (Williams et al. 2019). The time series of scallop population estimates published in versions of the Plenary report before 2019 were produced by applying historical estimates of dredge efficiency derived from previous studies of dredge efficiency by Cranfield et al. (1996) and Handley et al. (2004). New research on dredge efficiency conducted in 2018 in Marlborough Sounds estimated that the average efficiency of the survey dredge was 0.21 (95% CI from 0.17 to 0.27) (Tuck et al. 2018), which is substantially lower than estimated previously (mean historical efficiency of 0.56). Williams et al. (2019) re-analysed the 1997–2019 time series of surveys by applying the new dredge efficiency parameters derived by Tuck et al. (2018) and conducting growth projections using an inverse logistic model (Tuck & Williams 2012).

From the revised SCA 7 survey series analysis conducted by Williams et al. (2019) and updated by Williams et al. (2021) and Williams et al. (2024), abundance indices were generated for pre-recruits (undersize scallops 53–89 mm in length) and recruited scallops (90 mm or larger) (Figure 5). Strong patterns of recruitment are evident, illustrated by peaks in recruited numbers lagging one year after peaks in undersize scallop numbers. At the overall sub-stock scale (Golden Bay, Tasman Bay,

Marlborough Sounds), recruitment (as measured by the abundance of pre-recruits) has been low (or following a declining trend in some areas) since at least 2010.

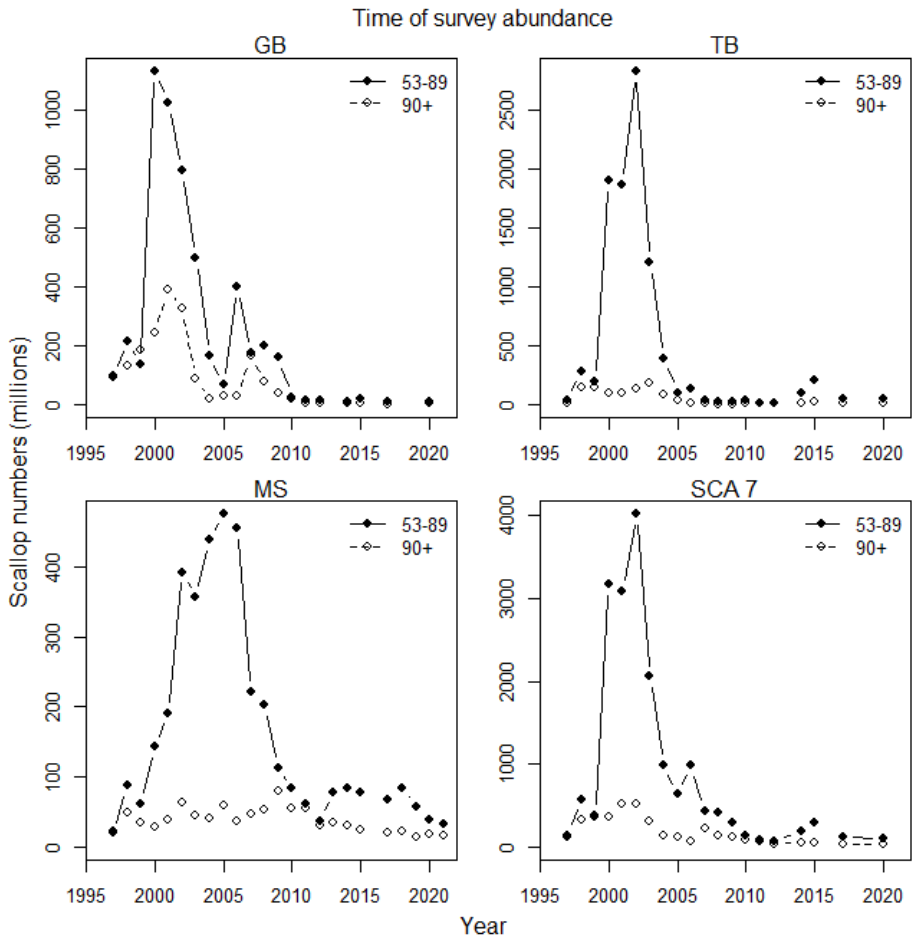


Figure 5: Time of survey abundance indices for pre-recruits (53–89 mm) and recruited scallops (90 mm or larger) from 1997 to 2021 by sub-stock (Golden Bay, GB; Tasman Bay, TB; Marlborough Sounds, MS) and total SCA 7 stock. There was no survey in 2016, and Golden Bay and Tasman Bay were not surveyed in 2013, 2018, 2019, or 2021. Values are median estimates of abundance (scallop numbers), corrected for dredge efficiency (Tuck et al. 2018).

5.2 Biomass estimates

Virgin biomass, B_0, and the biomass that will support the maximum sustainable yield, B_{MSY}, have not been estimated and are probably not appropriate reference points for a stock with highly variable recruitment and growth such as scallops.

Start of season (nominally 1 September) absolute recruited biomass is estimated each year from a pre-season dredge survey, which is usually conducted in May (N.B. January in 2017 and 2018). Estimates were derived by Williams et al. (2019) by re-analysing the 1997–2019 survey data, applying new dredge efficiency parameters (Tuck et al. 2018), and conducting growth projections with an inverse logistic model (Tuck & Williams 2012), using a resampling with replacement analytical procedure described to account for uncertainty in the start-of-season biomass estimates; the same approach was used by Williams et al. (2021) and Williams et al. (2024) to estimate the 2020 and 2021 biomass (Table 7).

Table 7: Projected median biomass (and CV) of recruited scallops (90 mm or longer shell length) at the nominal start of season (1 September) in the survey years, 1997 to present. Golden Bay and Tasman Bay were not surveyed in 2013, 2016, 2018, 2019, or 2021. No survey was conducted in 2016. Estimates were derived by Williams et al. (2019) by re-analysing the 1997–2019 survey data using a resampling with replacement analytical procedure, applying new dredge efficiency parameters (Tuck et al. 2018) and conducting growth projections with an inverse logistic model (Tuck & Williams 2012). The same approach was used to estimate the biomass in 2020 and 2021 (Williams et al. 2021, 2024). For each year, the catch (reported on the 'Landed' section of CELRs) and exploitation rate (catch to recruited biomass ratio) are also given. Biomass and catch are in tonnes meatweight. The old estimates can be found in Fisheries New Zealand (2018) page 404, table 8.

	Golden Bay					Tasman Bay			
Year	Biomass (t)	CV	Catch	Catch/Biomass	Year	Biomass (t)	CV	Catch	Catch/Biomass
1997	1 253	0.17	239	0.19	1997	110	0.19	2	0.02
1998	1 857	0.17	353	0.19	1998	1 617	0.17	78	0.05
1999	2 202	0.18	514	0.23	1999	1 425	0.18	155	0.11
2000	4 155	0.17	303	0.07	2000	1 570	0.21	19	0.01
2001	5 271	0.17	660	0.13	2001	2 460	0.26	32	0.01
2002	4 537	0.16	370	0.08	2002	3 267	0.27	39	0.01
2003	1 419	0.17	28	0.02	2003	2 997	0.18	107	0.04
2004	337	0.23	20	0.06	2004	1 269	0.18	47	0.04
2005	410	0.18	35	0.09	2005	477	0.17	5	0.01
2006	965	0.27	26	0.03	2006	106	0.21	0	–
2007	2 214	0.18	128	0.06	2007	86	0.30	0	–
2008	1 071	0.19	76	0.07	2008	29	0.38	0	–
2009	608	0.21	19	0.03	2009	39	0.32	0	–
2010	240	0.22	10	0.04	2010	128	0.65	0	–
2011	62	0.29	1	0.02	2011	121	0.65	0	–
2012	50	0.32	0.2	0.00	2012	47	0.41	0	–
2013	–	–	0	–	2013	–	–	0	–
2014	92	0.21	0	–	2014	190	0.30	0	–
2015	43	0.33	0	–	2015	498	0.34	0.8	0.00
2016	–	–	0	–	2016	–	–	0	–
2017	25	0.33	0	–	2017	178	0.35	0	–
2018	–	–	0	–	2018	–	–	0	–
2019	–	–	0	–	2019	–	–	0	–
2020	31	0.28	0	–	2020	122	0.75	0	–
2021	–	–	0	–	2021	–	–	0	–

	Marlborough Sounds					SCA 7 Total			
Year	Biomass (t)	CV	Catch	Catch/Biomass	Year	Biomass (t)	CV	Catch	Catch/Biomass
1997	252	0.16	58	0.23	1997	1 620	0.15	299	0.18
1998	520	0.18	117	0.22	1998	3 990	0.16	548	0.14
1999	378	0.16	7	0.02	1999	4 024	0.16	676	0.17
2000	373	0.17	16	0.04	2000	6 084	0.17	338	0.06
2001	449	0.17	25	0.06	2001	8 219	0.18	717	0.09
2002	862	0.19	62	0.07	2002	8 705	0.19	471	0.05
2003	542	0.17	71	0.13	2003	4 992	0.16	206	0.04
2004	543	0.18	51	0.09	2004	2 154	0.17	118	0.05
2005	712	0.18	116	0.16	2005	1 606	0.16	157	0.10
2006	541	0.21	43	0.08	2006	1 613	0.23	68	0.04
2007	662	0.22	6	0.01	2007	2 986	0.17	134	0.04
2008	695	0.17	28	0.04	2008	1 803	0.17	104	0.06
2009	920	0.20	101	0.11	2009	1 571	0.17	120	0.08
2010	641	0.15	74	0.12	2010	1 020	0.17	85	0.08
2011	669	0.16	60	0.09	2011	846	0.18	61	0.07
2012	361	0.17	48	0.13	2012	458	0.17	48	0.10
2013	416	0.17	43	0.10	2013	–	–	43	–
2014	376	0.17	22	0.06	2014	658	0.17	22	0.03
2015	305	0.17	21	0.07	2015	853	0.24	22	0.03
2016	–	–	0	–	2016	–	–	0	–
2017	345	0.19	0	–	2017	554	0.23	0	0.00
2018	335	0.17	0	–	2018	–	–	0	–
2019	203	0.20	0	–	2019	–	–	0	–
2020	242	0.16	0	–	2020	387	0.27	0	–
2021	189	0.17	0	–	2021	–	–	0	–

Biomass occurs at various spatial densities (scallops per unit area) throughout the stock, typically with smaller areas of high-density aggregations commonly known as 'beds' distributed among larger areas of low densities or no scallops. High-density scallop beds are important both for sustainability (i.e., larval production) and for fisheries utilisation (i.e., high catch rates). It is possibly more useful for management purposes to focus on biomass trends in the higher density areas. In addition to estimates

of absolute biomass (Figure 6), the biomass at different commercial threshold ('critical') densities (in the range 0–0.2 scallops m^{-2}) is also estimated each year. Estimates of September 2020 projected biomass decreased with increasing critical threshold density: the decrease was rapid in Golden Bay where recruited densities were especially low, but more gradual in Tasman Bay and Marlborough Sounds (Figure 7). Of the Marlborough Sounds 2020 absolute projected biomass, 53% (130 t) was in areas with a critical density of 0.2 m^{-2} or higher (Williams et al. 2021); in 2021, only an estimated 40% (75 t) occurred in areas with a critical density of 0.2 m^{-2} or higher (Williams et al. 2024). These are median point estimates, which have increasingly large uncertainty as the critical density threshold increases.

The May 2020 survey of SCA 7 (Williams et al. 2021) and the May 2021 survey of the Marlborough Sounds with additional targeted sampling in Tasman Bay (Williams et al. 2024) provide the most recent information to assess the status of the SCA 7 scallop population within the area surveyed. The key finding was that the overall SCA 7 recruited biomass in 2020 was the lowest on record. At the scale of each sub-stock, recruited biomasses in Golden Bay and Tasman Bay in 2020 remained at negligible levels, similar to those observed since the large declines in the 2000s. Recruited biomass in the Marlborough Sounds in 2020 and 2021 also remained low, at a level similar to that in 2019.

Within Golden Bay, the only evidence of a scallop bed in 2020 within the area surveyed was to the south of the tip of Farewell Spit. Recruited biomass was also very low within Tasman Bay, apart from slightly higher levels in Croisilles Harbour and in sector G where the 2020 and 2021 sampling provided evidence of a bed of scallops and horse mussels off The Glen in south-eastern Tasman Bay that was not detected in the previous survey there in 2017.

Within Marlborough Sounds, most of the recruited biomass in 2020 and 2021 occurred in the outer Sounds and Dieffenbach Point. Recruitment, as measured by the abundance of pre-recruit scallops, continues to follow a declining trend, or remains consistently low, except for at the Chetwode Islands where the level of recruitment is similar to the 1997–2020 historical average. Recruitment in Queen Charlotte Sound is following a steeply declining trend and is currently below the average level for that area.

Before the 2016–present fishery closures, commercial fishing (e.g., 22 t in the 2015 season) was limited almost exclusively to a few specified areas in the Marlborough Sounds. The level of recreational harvest in most years was unknown. The commercial exploitation rate in 2015 in the Marlborough Sounds was in line with the target exploitation rate associated with an increasing biomass observed between 1999 and 2008 (see section 5.4). A minimum reference level has not yet been established for SCA 7, and, because spatial scale is inherently important in scallop population dynamics and fisheries, a single minimum reference level for the stock would be unsuitable. It is clear, however, that the stocks in Golden Bay and Tasman Bay are well below desirable minimum levels, and the stock in the overall Marlborough Sounds is similar to the lowest recorded levels in the survey time series.

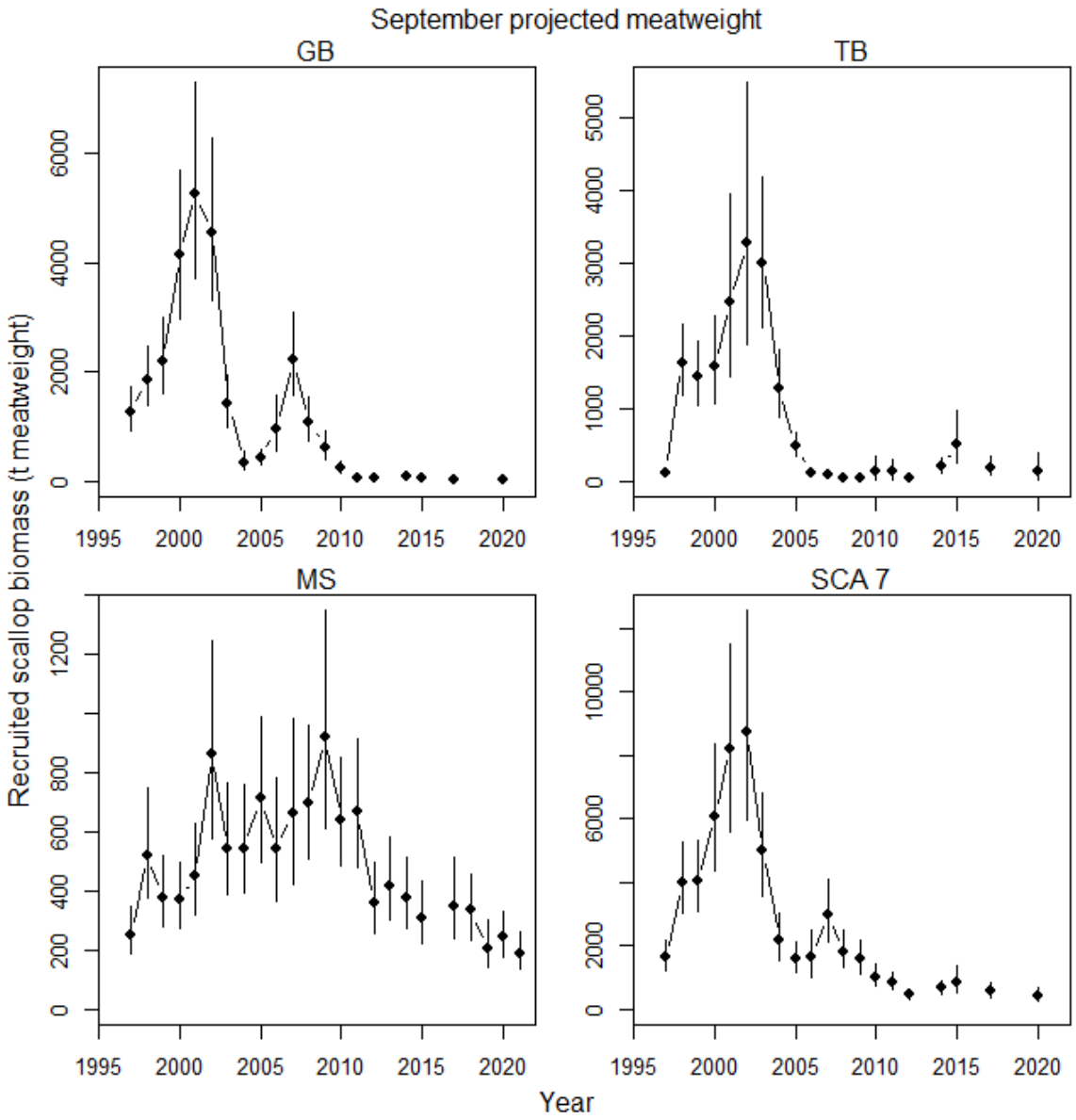


Figure 6: Trends in projected start of season (1 September, black symbols) biomass (t, meatweight) of recruited scallops (90 mm or larger) by sub-stock (GB, Golden Bay; TB, Tasman Bay; MS, Marlborough Sounds) and for the total SCA 7 stock, 1997–2020. Values are the estimated median and 95% confidence intervals of the recruited biomass, derived using dredge efficiency estimated by Tuck et al. (2018). Golden Bay and Tasman Bay were not surveyed in 2013, 2016, 2018, or 2019. Marlborough Sounds was not surveyed in 2016.

In addition to the May 2021 dredge survey of scallops in historically monitored areas, a dive survey was conducted in June 2021 to provide estimates of the scallop population occurring within non-commercial areas in the Marlborough Sounds and Croisilles Harbour and to provide information on the habitat characteristics of these areas to advance understanding of scallop-habitat associations. Within the combined area (5.6 km^2) of the non-commercial strata surveyed, the June 2021 biomass of recruited scallops (90 mm or larger) was an estimated 41 t greenweight (CV of 24%) or 5 t meatweight (assuming 12.5% recovery of meatweight from greenweight). Recruited densities in the non-commercial strata surveyed were highest in inner Queen Charlotte Sound (QCS), intermediate in outer QCS, Port Gore, and Croisilles Harbour, and lowest in Pelorus Sound and Guards/Anakoha bays. Recruited densities in some of the non-commercial areas surveyed by diving in June 2021 were comparable with densities estimated by the May 2021 dredge survey of historically monitored areas.

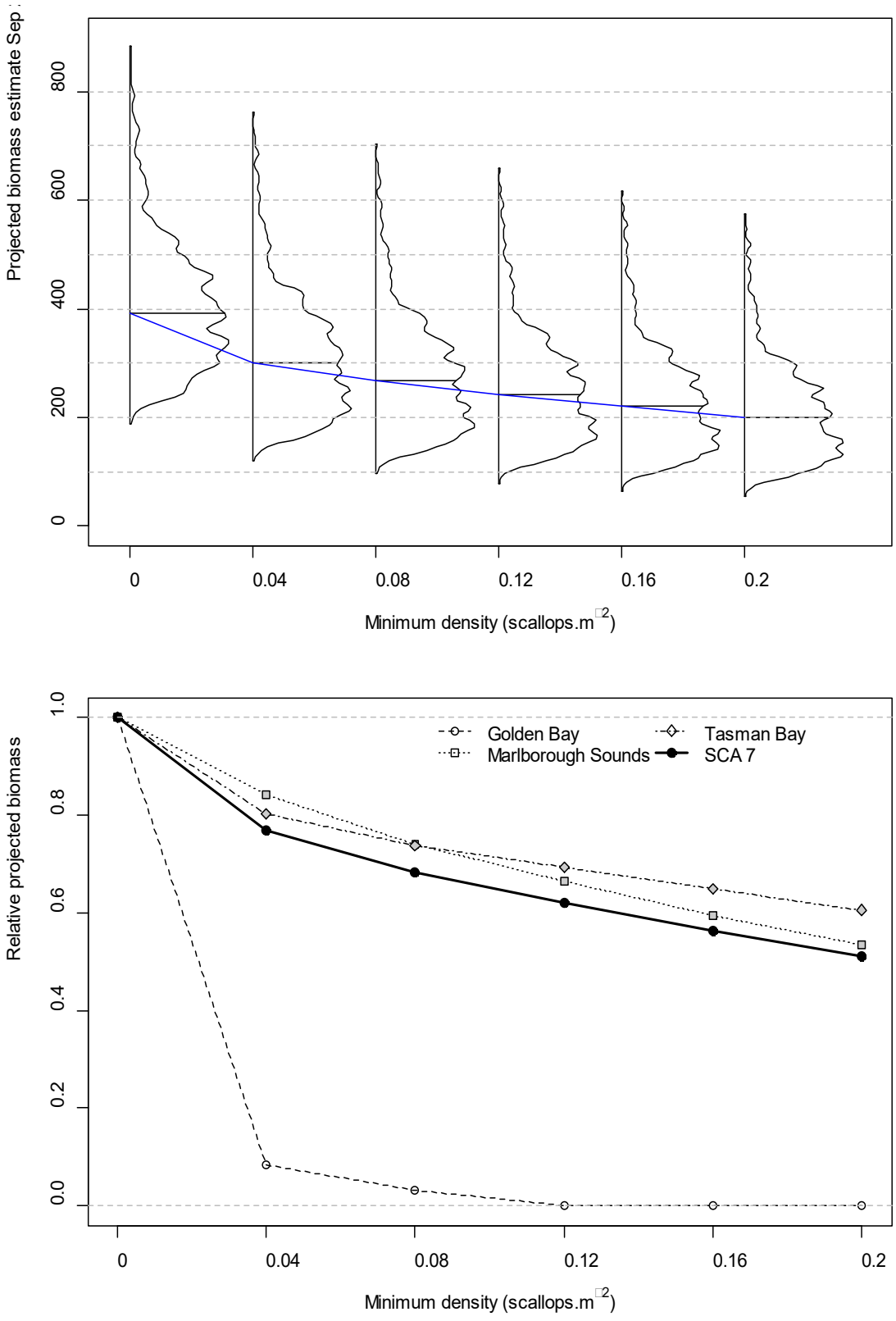


Figure 7: Effect of excluding areas of low scallop density on September projected estimates of recruited biomass, SCA 7, 2020. Critical density corrections were applied after correcting for dredge efficiency (Tuck et al. 2018). [Top]: for each minimum ('critical') density, the distribution and median (horizontal line) of the recruited biomass in SCA 7 are shown. [Bottom]: Trend in the proportion of the total recruited biomass with increasing critical density, by sub-stock and overall stock: Golden Bay (circles); Tasman Bay (diamonds); Marlborough Sounds (squares); SCA 7 (black circles joined by solid black line).

5.3 Estimation of Maximum Constant Yield (MCY)

MCY has not been estimated for SCA 7 scallops because it is not thought to be a reasonable management approach for highly fluctuating stocks such as scallops.

5.4 Estimation of Target Harvest (Exploitation) Rate

Historically, Current Annual Yield (CAY) has not been estimated for Golden Bay and Tasman Bay because those areas are managed under s14 of the Fisheries Act 1996.

For the Marlborough Sounds, CAY has historically been estimated using $F_{0.1}$ as the reference fishing mortality. Estimates of $F_{0.1}$ have been high and the Plenary agreed that this has resulted in overestimation of potential yield, particularly when fishing tends to focus on a small proportion of the biomass. The agreed new approach is to calculate an empirical target harvest (exploitation) rate based on a period when the Marlborough Sounds biomass was stable or increasing (i.e., the aim is to avoid harvest rates that tend to lead to biomass decline). The previous estimate of this target was a harvest rate (catch to biomass ratio) of 0.22, which was the mean harvest rate in the period 1999–2008 calculated using biomass estimates derived by applying historical dredge efficiency parameters. However, using the revised estimates of 1999–2008 biomass (Williams et al. 2019) generated by applying the new dredge efficiency parameters (Tuck et al. 2018) suggests a target harvest rate of 7% of the absolute recruited biomass. Further research is required to inform the setting of appropriate target and biomass limit reference points.

A review of reference points (management targets and limits) for scallop fisheries was undertaken in 2025; a brief summary of the review is provided in section 5 of the Introduction – Scallops chapter, and the findings will be published in a forthcoming report (Williams & Underwood, in review).

6. STATUS OF THE STOCKS

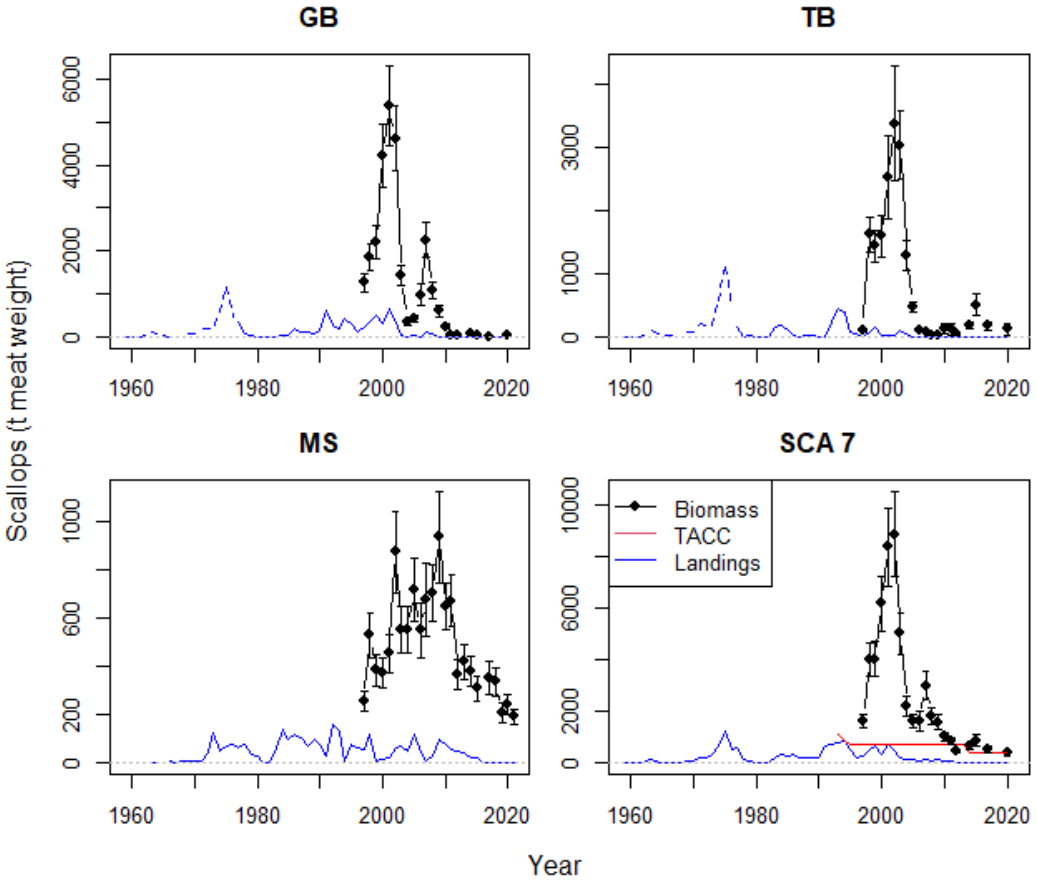
Stock structure assumptions

The stock structure of scallops in New Zealand waters is uncertain. For the purposes of this assessment and due to the different management regimes, Golden Bay, Tasman Bay, and Marlborough Sounds are assumed to be individual and separate sub-stocks of SCA 7.

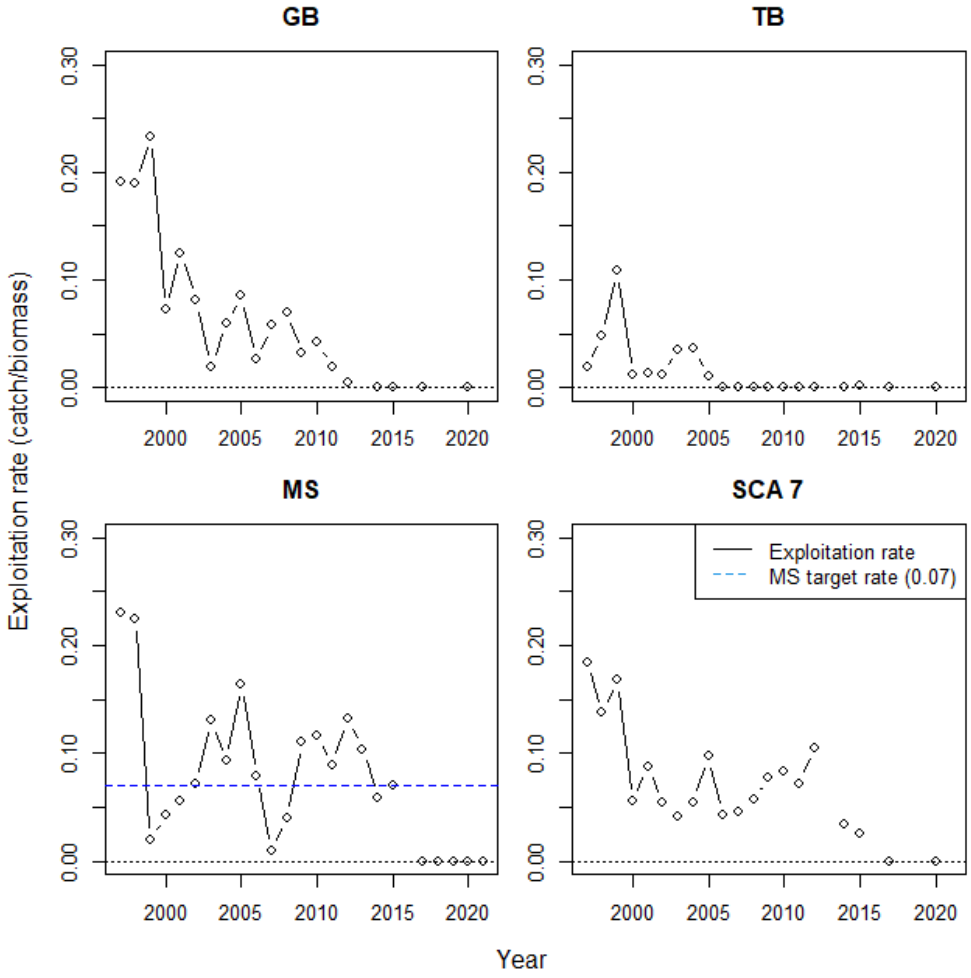
Stock Status		
Most Recent Assessment Plenary Publication Year	2021	
Intrinsic productivity level	High	
Catch in most recent year of assessment	Year:	Catch:
Assessment Runs Presented	Biomass estimates for Golden Bay and Tasman Bay up to 2020, and for Marlborough Sounds up to 2021	
Reference Points	Target: Empirical target harvest (exploitation) rate: U_{MSY} = U_{target} = 0.07 for Marlborough Sounds. No targets have been set for Golden Bay or Tasman Bay; B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0	
Status in relation to Target	Very Likely (> 90%) to be at or below U_{target} for Marlborough Sounds. Very Unlikely (< 10%) to be at or above the biomass target for Golden Bay or Tasman Bay	
Status in relation to Limits	Unknown for the soft and hard limits for Marlborough Sounds Very Likely (> 90%) to be below the soft limit for Golden Bay and Tasman Bay	

	Likely (> 60%) to be below the hard limit for Golden Bay and Tasman Bay
Status in relation to Overfishing	For sustainability reasons, the SCA 7 fishery was partially closed during the 2016–17 fishing year and the closure was extended to the entire SCA 7 QMA plus Port Underwood from the 2017–18 fishing year. The closure will remain in place until such a time as the scallop population has recovered. Therefore, overfishing is Very Unlikely (< 10%) to have occurred in 2019–20.

Historical Stock Status Trajectory and Current Status



Estimated September projected biomass (mean and CV), TACC, and reported landings of recruited scallops (90 mm or larger shell length) in t meatweight by sub-stock (GB, Golden Bay; TB, Tasman Bay; MS, Marlborough Sounds) and overall SCA 7 stock since 1959. Biomass estimated by correcting for dredge efficiency using parameters estimated by Tuck et al. (2018). Landings before 1977 from Golden Bay and Tasman Bay were reported as combined values from the two bays (shown as a dashed blue line). Scale of y-axis differs between plots. The fishery in the Marlborough Sounds and Tasman Bay sector H areas were closed for the 2016–17 scallop fishing year, and the fishery closure was extended in 2017–18 to cover the entire SCA 7 stock and adjacent Port Underwood area.



Harvest or exploitation rate (catch divided by biomass) trends for recruited scallops by region and for the overall SCA 7 stock (solid black lines). For the Marlborough Sounds, the target harvest rate value of 0.07 is shown as a horizontal dashed line, calculated using revised estimates of biomass derived by Williams et al. (2019); this is an empirical target based on the mean harvest rate (catch to biomass ratio) in the period 1999–2008 when the Marlborough Sounds biomass was stable or increasing. This target has been in place since 2014.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Recruited biomass in Marlborough Sounds generally declined from 2009 to 2015, showed little change to 2018, then declined further to reach the lowest recorded level in 2021. Golden Bay and Tasman Bay biomasses remained extremely low in 2020 with no indication of rebuilding, except for dredge and video survey evidence of a patch of scallops and horse mussels to the northwest of The Glen in Tasman Bay.
Recent Trend in Fishing Intensity or Proxy	Marlborough Sounds harvest rate (catch to recruited biomass ratio) was high at 23% and 22% in 1997 and 1998 but dropped to 2% in 1999, followed by a general increase to reach 16% in 2005. The harvest rate subsequently decreased to 1% in 2007, followed by an increasing trend to reach 13% in 2012. In the years 2013 to 2015 the harvest rate was in the range 6–10%. The fishery was closed in 2016. In Golden Bay, the harvest rate was high in the period 1997–99 (19–

	23%), followed by a decreasing trend with fluctuation from 2000, and was very low (<1%) in 2012. No fishing has occurred in Golden Bay since the 2012 fishing season. The fishery was closed in the 2017–18 fishing year. In Tasman Bay, the peak harvest rate in the time series was 11% in 1999, but otherwise has been low. No fishing occurred in Tasman Bay between 2006 and 2014, and there was minimal (exploratory) fishing in Tasman Bay in 2015 (harvest rate of <1%). Sector 7HH in Tasman Bay was closed in the 2016–17 fishing year and the entire Tasman Bay area was closed in the 2017–18 fishing year.
Other Abundance Indices	-
Trends in Other Relevant Indicator or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Stock projections are not available. The success of natural settlement, survivorship on the seabed, and the magnitude of incidental mortality are unknown.
Probability of Current Catch or TAC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unknown
Probability of Current Catch or TAC causing Overfishing to continue or commence	For sustainability reasons, the SCA 7 fishery was partially closed during the 2016–17 fishing year and the closure was extended in 2017–18 to cover the entire SCA 7 QMA plus Port Underwood. The closure continues and will remain in place until such a time as the scallop population has recovered.

Assessment Methodology and Evaluation		
Assessment Type	Level 2 – Partial Quantitative Stock Assessment	
Assessment Method	Biomass surveys	
Assessment Dates	Latest assessment Plenary publication year: 2020 (Golden Bay and Tasman Bay) and 2021 (Marlborough Sounds)	Next assessment: 2023
Overall Assessment Quality Rank	1 – High Quality	
Main data inputs (rank)	Biomass survey: 2020 (Golden Bay, Tasman Bay, and Marlborough Sounds)	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	- Use of an empirical harvest rate (U_{target}) in preference to $F_{0.1}$	
Major Sources of Uncertainty	- dredge efficiency (efficiency and selectivity) during the survey - growth rates and natural mortality between the survey and the start of the season and among areas - predicting the average recovery of meatweight from greenweight for the time of the fishing season - the spatial scale at which the assessment is conducted (currently, the target harvest rate is calculated at a broad scale using estimates of absolute biomass, but, before the 2016 closure, fishing occurred only in a few high-density scallop beds that support productive fishing and are also likely to be the most important spawning beds)	

	- the extent to which dredging causes incidental mortality and affects recruitment - appropriate limit reference points for scallops- appropriate limit reference points for scallops

Qualifying Comments
The extent to which the various beds or populations are reproductively or functionally separate is not known. In addition to direct fishing mortality, a combination of other anthropogenic (e.g., land-based influences, indirect effects of fishing) and natural (e.g., oceanographic) drivers may have affected the productivity of the SCA 7 fishery. Declines in stocks of other shellfish (oysters and mussels) have also been observed in Golden Bay and Tasman Bay.

7. FOR FURTHER INFORMATION

Boyd, R O; Gowing, L; Reilly, J L (2004) 2000–2001 national marine recreational fishing survey: diary results and harvest estimates. (Unpublished New Zealand Fisheries Assessment Research Report for the Ministry of Fisheries Project REC2000-01 held by Fisheries New Zealand, Wellington.) 92 p.

Boyd, R O; Reilly, J L (2004) 1999/2000 National Marine Recreational Fishing Survey: harvest estimates. (Unpublished New Zealand Fisheries Assessment Research Report for the Ministry of Fisheries Project REC9803 held by Fisheries New Zealand, Wellington.) 28 p.

Bradford, E (1998) Harvest estimates from the 1996 national marine recreational fishing surveys. *New Zealand Fisheries Assessment Research Document 98/16*. 27 p. (Unpublished report held in NIWA library, Wellington.)

Bradford-Grieve, J; Bull, M; Drummond, K; Gordon, D; Laing, A; Mackenzie, L; Moore, M; Murdoch, R; Nodder, S (1994) Summary of knowledge of the Tasman and Golden Bay marine environment relevant to fisheries enhancement. Report prepared for Southern Scallops Fishery Advisory Committee, MAF Fisheries (Central), and Tasman District Council. 179 p. (Unpublished report held by NIWA, Auckland.)

Breen, P A (1995) Report on the MLS implications for Challenger scallops. 21 p. (Unpublished report held by Fisheries New Zealand, Wellington.)

Breen, P A; Kendrick, T H (1997) A model to evaluate fishing strategies for the Challenger scallop fishery. NIWA Client Report WLG97/36 prepared for Challenger Scallop Enhancement Co.

Bull, M F (1976) Aspects of the biology of the New Zealand scallop, *Pecten novaezelandiae* Reeve 1853, in the Marlborough Sounds. PhD thesis, Victoria University of Wellington.

Bull, M F; Drummond, K L (1994) Report on Tasman Bay and Golden Bay scallop mortality trials. *Central Fisheries Region Internal Report No. 24*. 17 p.

Choat, J H (1960) Scallop Investigation, Tasman Bay 1959–60. New Zealand Marine Department. *Fisheries Technical Report 2*. 47 p.

Cole, R; Horn, P L; Davey, N; Bradley, A (2006) An estimate of the recreational catch of scallops and dredge oysters in the Golden bay and Tasman bay sections of the Southern Scallop Fishery (SCA 7) for the 2003–04 fishing season. *New Zealand Fisheries Assessment Report 2006/10*. 26 p.

Cranfield, J; Michael, K; Doonan, I (1996) Biomass of scallops in Golden Bay, Tasman Bay and the Marlborough Sounds, 1996. NIWA Client Report 1996/14-WN. 23 p. (Unpublished report held by NIWA library, Wellington.)

CSEC (1998) Southern Scallop Fishery Enhancement Plan. Report prepared by Challenger Scallop Enhancement Company Limited, approved by the Minister of Fisheries. 46 p. (Unpublished report held by CSEC Ltd., Nelson.)

CSEC (2005) Southern Scallop Fishery Draft Fisheries Plan. Report prepared by Challenger Scallop Enhancement Company Limited. 30 p. (Unpublished report held by CSEC Ltd., Nelson.)

Doonan, I J; McKoy, J L; Bull, M F; Stead, D H (1985) Scallop surveys in the Nelson and Marlborough regions, 1960–82. *Fisheries Research Division Occasional Publication: Data Series No. 18*. 65 p.

Fisheries New Zealand (2018) Fisheries Assessment Plenary, November 2018: stock assessments and stock status. Compiled by the Fisheries Science and Information Group, Fisheries New Zealand, Wellington, New Zealand. 526 p.

Fisheries New Zealand (2021) Implementation plan for the Marlborough Sounds' Southern Scallop strategy. https://www.mpi.govt.nz/dmsdocument/44902-Implementation-plan-Southern-Scallop-Strategy-Marlborough-Sounds. Last accessed 02/12/2021.

Handley, S; Brown, S; Horn, P (2004) Video estimates of dredge efficiency of the CSEC scallop dredge. NIWA Client Report, NEL 2003-018. 27 p. (Unpublished report held by NIWA library, Wellington.)

Heinemann A; Gray, A (2024) National Panel Survey of Recreational Marine Fishers 2022-23. *New Zealand Fisheries Assessment Report 2024/51*. 116 p.

King, M R; McKoy, J L (1984) Scallop landings in the Nelson-Marlborough dredge fishery, 1959–80. *Fisheries Research Division Occasional Publication: Data Series No. 14*. 26 p.

Ministry of Fisheries & CSEC (1998) Memorandum of understanding between the Ministry of Fisheries and Challenger Scallop Enhancement Company Limited. Agreement between the Chief Executive of the Ministry of Fisheries and CSEC Ltd regarding the provision of information necessary to manage the SCA 7 fishery. 16 p. (Unpublished agreement held by Fisheries New Zealand, Wellington, and CSEC Ltd., Nelson.)

Ministry for Primary Industries (2013) Fisheries Assessment Plenary, May 2013: stock assessments and yield estimates. Compiled by the Fisheries Science Group, Ministry for Primary Industries, Wellington, New Zealand. 1357 p.

Ministry for Primary Industries (2016) Review of sustainability measures for the Southern Scallop Fishery (SCA 7). Retrieved from https://mpi.govt.nz/news-and-resources/consultations/review-of-sustainability-measures-for-the-southern-scallop-fishery-sca-7.

Ministry for Primary Industries (2017) Temporary Closure of the Southern Scallop (SCA 7) Fishery. Retrieved from https://www.mpi.govt.nz/news-and-resources/consultations/temporary-closure-of-the-southern-scallop-sca-7-fishery.

Shumway, S; Parsons, G J (2006) Scallops: Biology, Ecology and Aquaculture, *Developments in Aquaculture and Fisheries Science Volume 40.* 2nd edition. Elsevier Science. 1500 p.

Teirney, L D; Kilner, A R; Millar, R B; Bradford, E; Bell, J D (1997) Estimation of recreational harvests from 1991–92 to 1993–94. *New Zealand Fisheries Assessment Research Document 97/15*. 43 p. (Unpublished report held by NIWA library, Wellington.)

Tuck, I; Brown, S (2008) Survey of scallops and oysters in Golden Bay, Tasman Bay, and the Marlborough Sounds, 2008. *NIWA Client Report NEL2008-022*. 37 p. (Unpublished report held by NIWA, Auckland.)

Tuck, I D; Williams, J R (2012) Scallop growth. Final Research Report for Ministry of Fisheries project SCA200903. 71 p. (Unpublished report held by Fisheries New Zealand, Wellington.)

Tuck, I D; Williams, J R; Bian, R (2018) SCA 7 dredge efficiency and fine scale catch modelling. Final Research Report for MPI project SCA2017-02: Objectives 2 & 3. 19 p. (Unpublished report held by Fisheries New Zealand, Wellington.)

Williams, J R; Bian, R; Olsen, L; Stead, J (2021) Survey of scallops in SCA 7, May 2020. *New Zealand Fisheries Assessment Report 2021/09*. 54 p.

Williams, J R; Bian, R; Carter, M; Evans, O; Hughes, R; Jordan, L; Middleton, C; Olsen, L; Stead, J (2024) Dive and dredge surveys of scallops in SCA 7, 2021. *New Zealand Fisheries Assessment Report 2024/57*. 51 p.

Williams, J R; Bian, R; Olsen, L; Stead, J; Tuck, I (2019) Dredge survey of scallops in Marlborough Sounds, May 2019. *New Zealand Fisheries Assessment Report 2019/69*. 50 p.

Williams, J R; Bian, R; Parkinson, D P; Roberts, C L (2015a) Survey of scallops in Golden Bay, Tasman Bay, and Marlborough Sounds, 2015. NIWA Client Report AKL2015-019 prepared for Challenger Scallop Enhancement Company Ltd. NIWA Project CSE15301. 71 p. (Unpublished report held by NIWA, Auckland.)

Williams, J R; Hartill, B; Bian, R; Williams, C L (2014) Review of the Southern scallop fishery (SCA 7). *New Zealand Fisheries Assessment Report 2014/07*. 71 p.

Williams, J R; Parkinson, D M; Olsen, L; Bian, R (2018) Dredge survey of scallops in Marlborough Sounds, January 2018. *New Zealand Fisheries Assessment Report 2018/19*. 35 p.

Williams, J R; Parkinson, D M; Olsen, L; Roberts, C L (2015b) SCA 7 in-season survey, October 2015. *New Zealand Fisheries Assessment Report 2015/72*. 20 p.

Williams, J R; Parkinson, D P; Drury, J; Roberts, C L; Bian, R; Tuck, I D (2017) Survey of scallops in SCA 7, January 2017. *New Zealand Fisheries Assessment Report 2017/23*. 71 p.

Williams, J R; Roberts, C L; Parkinson, D M; MacGibbon, D; Olsen, L (2015c) SCA 7 stock survey, November 2015. *New Zealand Fisheries Assessment Report 2015/79*. 44 p.

Williams, J R; Underwood, M J (in review) Review of reference points (management targets and limits) for scallops. *New Zealand Fisheries Assessment Report* 20xx/xx. xx p.

Wynne-Jones, J; Gray, A; Heinemann, A; Hill, L; Walton, L (2019) National Panel Survey of Marine Recreational Fishers 2017–2018. *New Zealand Fisheries Assessment Report 2019/24*. 104 p.

Wynne-Jones, J; Gray, A; Hill, L; Heinemann, A (2014) National panel survey of marine recreational fishers in 2011–12: Harvest estimates. *New Zealand Fisheries Assessment Report 2014/67*. 139 p.