FLATFISH (FLA)

(*Colistium nudipinnis*, *Peltorhamphus novaezelandiae*, *Colistium guntheri*, *Rhombosolea retiaria*, *Rhombosolea plebeia*, *Rhombosolea leporina*, *Rhombosolea tapirina*, *Pelotretis flavilatus*)
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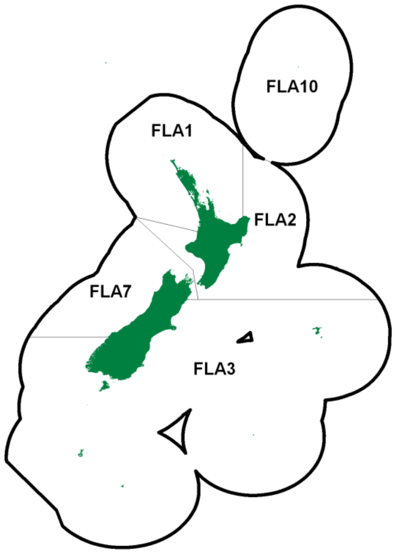
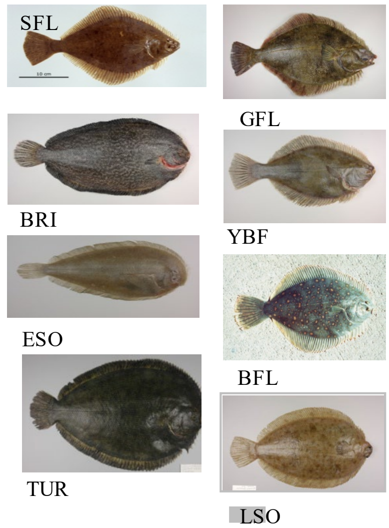




1. FISHERY SUMMARY

1.1 Commercial fisheries

Flatfish Individual Transferable Quota (ITQ) provides for the landing of eight species of flatfish in the QMS. These are: the yellowbelly flounder, *Rhombosolea leporine* (YBF); sand flounder, *Rhombosolea plebeian* (SFL); black flounder, *Rhombosolea retiaria* (BFL); greenback flounder, *Rhombosolea tapirina* (GFL); lemon sole, *Pelotretis flavilatus* (LSO); New Zealand sole, *Peltorhamphus novaezeelandiae* (ESO); brill, *Colistium guntheri* (BRI); and turbot, *Colistium nudipinnis* (TUR). For management purposes landings of these species are combined.

Flatfish are shallow water species, taken mainly by target inshore trawl and Danish seine fleets around the South Island. Setnet and drag net fishing are important in the northern harbours and the Firth of Thames. Important fishing areas are:

Yellowbelly flounder	Firth of Thames, Kaipara, and Manukau harbours;
Sand flounder	Hauraki Gulf, Tasman Bay/Golden Bay, Bay of Plenty, Canterbury Bight, and Te Wae Wae Bay;
Greenback flounder	Canterbury Bight, Southland;
Black flounder	Canterbury Bight;
Lemon sole	west coast South Island, Otago, and Southland;
New Zealand sole	west coast South Island, Otago, Southland, and Canterbury Bight;
Brill and turbot	west coast South Island.

TACCs were originally set at the level of the sum of the provisional ITQs for each fishery. Between 1983–84 and 1992–93 total flatfish landings fluctuated between 2750 t and 5160 t; from 1992–93 to 1997–98, landings were relatively consistent, between about 4500 t and 5000 t per year. Landings declined to 2963 t in 1999–00, the lowest recorded since 1986–87, before increasing to a peak of 4051 t for the 2006–07 fishing year. Landings thereafter declined to just 1939 t in 2018–19, the lowest landings recorded since 1975. Historical estimated and recent reported flatfish landings and TACCs are shown in Tables 1 and 2, and Figure 1 shows the historical landings and TACC values for the main FLA QMAs.

Flatfish TACCs were first introduced in the fishing year 1986–87. After some minor increases TACCs remained unchanged for all FLA Fishstocks until the 1st October 2007, when a TAC and allowances were set for the first time in FLA 3. The FLA 3 TACC was reduced by 47% to 1430 t and a management procedure (MP) that recommended an in-season increase in the commercial catch allowance if supported by early CPUE data was implemented (see section 4.3 for a description of this procedure – this MP has been suspended, beginning in 2019–20). All FLA fisheries have been listed in Schedule 2 of the Fisheries Act 1996. Schedule 2 allows that, for certain "highly variable" stocks, the Total Annual Catch (TAC) can be increased within a fishing season. Increased commercial catch is provided for through the creation of additional 'in-season' ACE. The base TACC is not changed by this process and the "in-season" TAC reverts to the original level at the end of each season. The FLA 3 management procedure (section 4.3) is an implementation of this form of management. Landings have remained well below the TACC for FLA 1, FLA 2, and FLA 7, and the TACC for FLA 1 was reduced to 890 t for the fishing year 2018–19.

From 1 October 2008, a suite of regulations intended to protect Mauī and Hector's dolphins was implemented for all of New Zealand by the Minister of Fisheries. Commercial and recreational set netting were banned in most areas to 4 nautical miles offshore of the east coast of the South Island, extending from Cape Jackson in the Marlborough Sounds to Slope Point in the Catlins. Some exceptions were allowed, including an exemption for commercial and recreational set netting to only one nautical mile offshore around the Kaikoura Canyon, and permitting set netting in most harbours, estuaries, river mouths, lagoons, and inlets, except for the Avon-Heathcote Estuary, Lyttelton Harbour, Akaroa Harbour, and Timaru Harbour. In addition, trawl gear within 2 nautical miles of shore was restricted to flatfish nets with defined low headline heights. The commercial minimum legal size for sand flounder is 23 cm, and for all other flatfish species is 25 cm.

Table 1: Reported landings (t) for the main QMAs from 1931 to 1982.

Year	FLA 1	FLA 2	FLA 3	FLA 7	Year	FLA 1	FLA 2	FLA 3	FLA 7
1931–32	767	290	219	265	1957	308	64	529	183
1932–33	958	219	61	276	1958	362	59	989	321
1933–34	698	277	181	346	1959	362	48	971	382
1934–35	708	203	83	195	1960	410	58	1 257	361
1935–36	686	118	57	209	1961	386	102	665	273
1936–37	438	127	139	139	1962	383	156	584	228
1937–38	570	125	380	123	1963	352	106	627	228
1938–39	717	83	639	94	1964	499	134	879	350
1939–40	721	128	448	83	1965	599	109	917	518
1940–41	1 004	180	494	101	1966	547	222	1 141	496
1941–42	943	139	622	139	1967	646	231	1 273	493
1942–43	591	192	594	154	1968	541	139	973	311
1943–44	669	89	606	172	1969	686	193	936	269
1944	441	104	783	78	1970	557	262	1 027	471
1945	435	104	984	83	1971	407	149	1 028	276
1946	392	168	1 264	146	1972	475	114	548	166
1947	551	99	1 685	198	1973	438	149	717	442
1948	433	93	1 494	214	1974	503	147	637	748
1949	412	76	1 473	202	1975	431	156	598	476
1950	284	31	1 446	176	1976	548	132	802	929
1951	308	62	1 178	135	1977	764	255	916	1 165
1952	349	94	1 117	166	1978	706	202	1 730	1 225
1953	349	149	1 510	197	1979	742	287	1 962	899
1954	376	112	1 184	213	1980	906	219	1 562	459
1955	377	125	913	248	1981	1 082	760	1 369	399
1956	308	106	772	190	1982	934	650	1 214	468

1. The 1931–1943 years are April–March but from 1944 onwards are calendar years. .
2. Data up to 1985 are from fishing returns: data from 1986 to 1990 are from Quota Management Reports.
3. Data for the period 1931 to 1982 are based on reported landings by harbour and are likely to be underestimated as a result of under-reporting and discarding practices. Data includes both foreign and domestic landings.

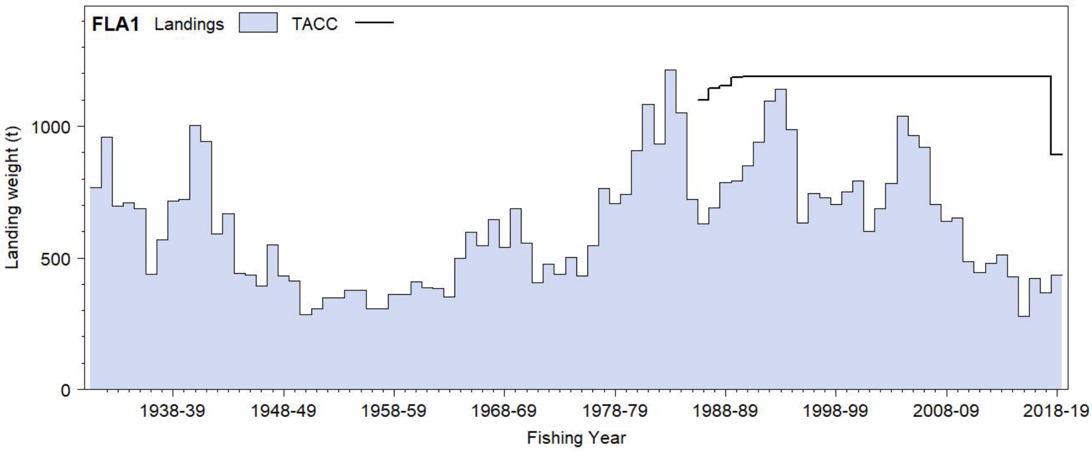
Table 2: Reported landings (t) of flatfish by Fishstock from 1983–84 to present and actual TACCs (t) from 1986–87 to present. QMS data from 1986–present. [Continued on next page]

Fishstock	FLA 1		FLA 2		FLA 3		FLA 7		FLA 10			
FMA (s)	1 & 9		2 & 8		3, 4, 5 & 6		7		10		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1983–84*	1 215	–	378	–	1 564	–	1 486	–	0	–	5 160	–
1984–85*	1 050	–	285	–	1 803	–	951	–	0	–	4 467	–
1985–86*	722	–	261	–	1 537	–	385	–	0	–	‡3 215	–
1986–87	629	1 100	323	670	1 235	2 430	563	1 840	0	10	‡2 750	6 050
1987–88	688	1 145	374	677	2 010	2 535	1 000	1 899	0	10	‡4 072	6 266
1988–89	787	1 153	297	717	2 458	2 552	757	2 045	0	10	4 299	6 477
1989–90	791	1 184	308	723	1 637	2 585	745	2 066	0	10	3 482	6 568
1990–91	849	1 187	292	726	1 340	2 681	502	2 066	0	10	2 983	6 670

Table 2 [Continued]

Fishstock	FLA 1		FLA 2		FLA 3		FLA 7		FLA 10			
FMA (s)	1 & 9		2 & 8		3, 4, 5 & 6		7		10		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landing	TACC
1991–92	940	1 187	288	726	1 229	2 681	745	2 066	0	10	3 202	6 670
1992–93	1 106	1 187	460	726	1 954	2 681	1 566	2 066	0	10	5 086	6 670
1993–94	1 136	1 187	435	726	1 926	2 681	1 108	2 066	0	10	4 605	6 670
1994–95	964	1 187	543	726	1 966	2 681	1 107	2 066	0	10	4 580	6 670
1995–96	628	1 187	481	726	2 298	2 681	1 163	2 066	1	10	4 571	6 670
1996–97	741	1 187	363	726	2 573	2 681	1 117	2 066	0	10	4 794	6 670
1997–98	728	1 187	559	726	2 351	2 681	1 020	2 066	0	10	4 657	6 670
1998–99	690	1 187	274	726	1 882	2 681	868	2 066	0	10	3 714	6 670
1999–00	751	1 187	212	726	1 583	2 681	417	2 066	0	10	2 963	6 670
2000–01	792	1 187	186	726	1 702	2 681	447	2 066	0	10	3 127	6 670
2001–02	596	1 187	177	726	1 693	2 681	614	2 066	0	10	3 080	6 670
2002–03	686	1 187	144	726	1 650	2 681	819	2 066	0	10	3 299	6 670
2003–04	784	1 187	218	726	1 286	2 681	918	2 066	0	10	3 206	6 670
2004–05	1 038	1 187	254	726	1 353	2 681	1 231	2 066	0	10	3 876	6 670
2005–06	964	1 187	296	726	1 177	2 681	1 283	2 066	0	10	3 720	6 670
2006–07	922	1 187	296	726	1 429	2 681	1 419	2 066	0	10	4 066	6 670
2007–08	703	1 187	243	726	1 365	1 430	1 313	2 066	0	10	3 624	5 419
2008–09	639	1 187	214	726	1 544	**1 780	1 020	2 066	0	10	3 417	5 419
2009–10	652	1 187	212	726	1 525	**1 763	884	2 066	0	10	3 273	5 835
2010–11	486	1 187	296	726	1 027	1 430	659	2 066	0	10	2 467	5 509
2011–12	445	1 187	262	726	1 507	1 430	646	2 066	0	10	2 861	5 419
2012–13	480	1 187	274	726	1 512	**1 727	526	2 066	0	10	2 792	5 716
2013–14	511	1 187	216	726	1 377	1 430	568	2 066	0	10	2 672	5 419
2014–15	426	1 187	166	726	1 231	1 430	640	2 066	0	10	2 464	5 419
2015–16	277	1 187	238	726	1 622	**1 650	656	2 066	0	10	2 792	5 639
2016–17	421	1 187	136	726	1 421	*#2 065	873	2 066	0	10	2 851	6 054
2017–18	367	1 187	108	726	886	1 430	651	2 066	0	10	2 014	5 419
2018–19	435	890	82	726	968	1 430	454	2 066	0	10	1 940	5 122
2019–20	404	890	74	726	1 001	1 430	430	2 066	0	10	1 910	5 122

* FSU data.
‡ Includes 11 t Turbot, area unknown but allocated to QMA 7.
§ Includes landings from unknown areas before 1986–87.
** Commercial catch allowance increased with additional 'in-season' ACE provided under S68 of Fisheries Act 1996
*# The increase in commercial catch under S68 of Fisheries Act 1996 was not approved until late August 2017



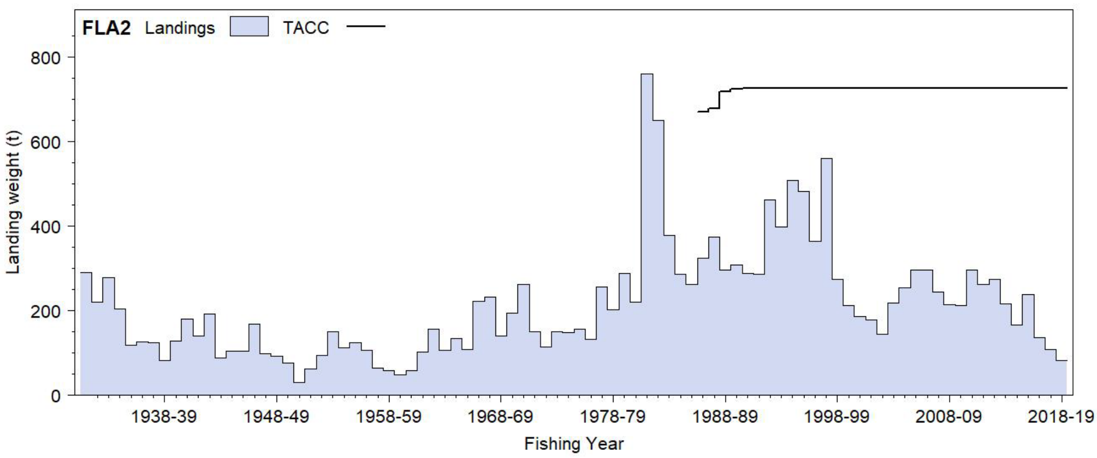
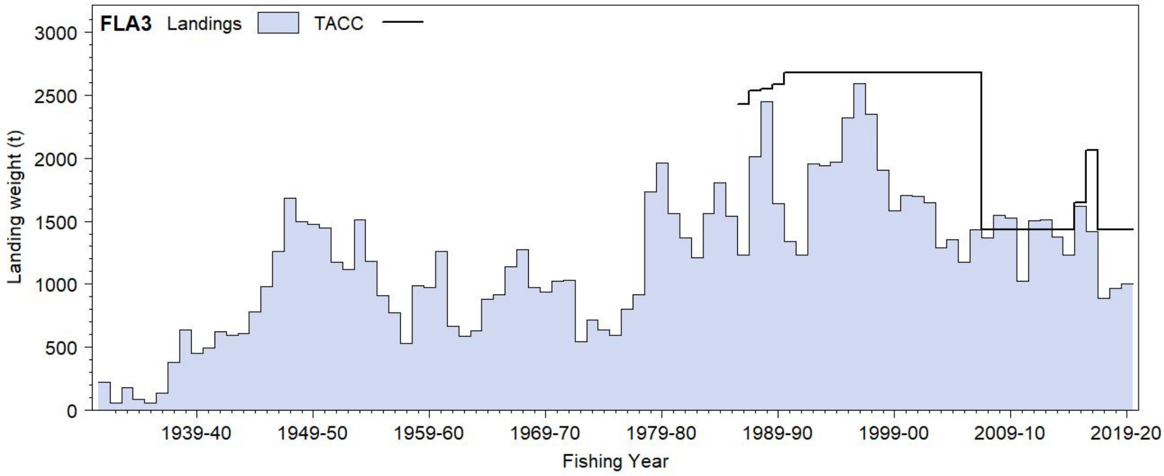


Figure 1: Historical landings and TACC for the four main FLA stocks. FLA 1 (Auckland) and FLA 2 (Central). [Continued on next page]



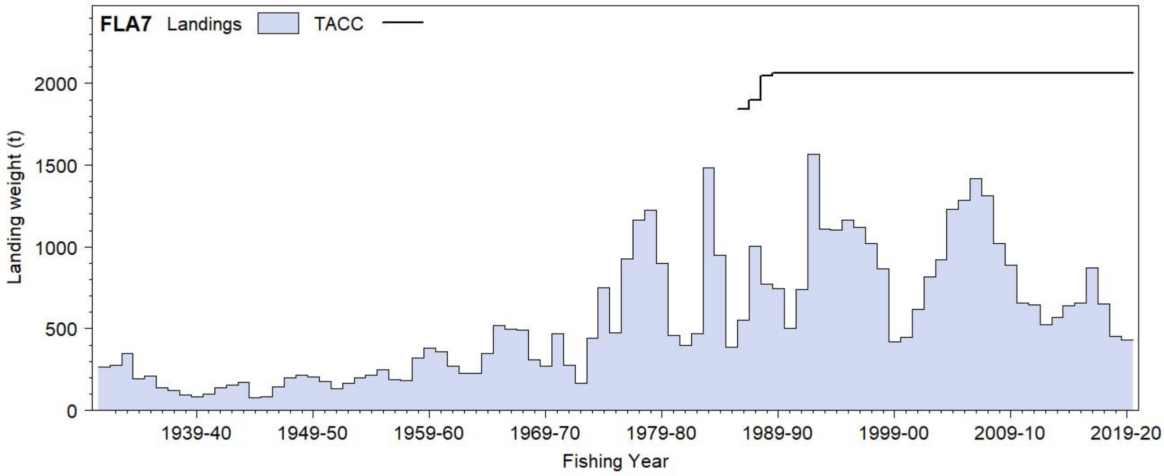


Figure 1 [Continued]: Historical landings and TACC for the four main FLA stocks. FLA 3 (South East Coast, South East Chatham Rise, Sub-Antarctic, Southland FLA 7 (West Coast South Island).

Fishers and processors are required to use a generic flatfish (FLA) code in the monthly harvest returns to report landed catches of flatfish species as well as in the landings section of the catch and effort forms. Fishers have been expected to use the specific flatfish species code when reporting estimated catches of flatfish since the 1990–91 fishing year. However, there is no penalty if fishers use the generic "FLA" code, so reporting by species has been inconsistent across years and FLA QMAs. Starr & Kendrick (2019b) found that very few FLA 1 fishers reported species-specific catch. Bentley (2009, 2010), when initially developing the FLA 3 MP, introduced the concept of "splitters", where derived species composition estimates were based on vessels which consistently reported estimated catches using species-specific species codes and avoided using the generic FLA code. Starr & Kendrick (2018) investigated four different definitions of "splitters", demonstrating all were roughly equivalent, but settled on the "trip splitter" definition, where every trip which did not use the FLA code for estimated catches but which landed FLA, was used. They showed that this definition maximised the proportion of the total landings included in the splitter category, which varied between 42 and 77% for FLA 3 and 24 to 80% for FLA 7 (Figure 2). The percentage distribution of species-specific catch for FLA 3 and FLA 7, based on "trip splitter" trips, is presented in Table 3.

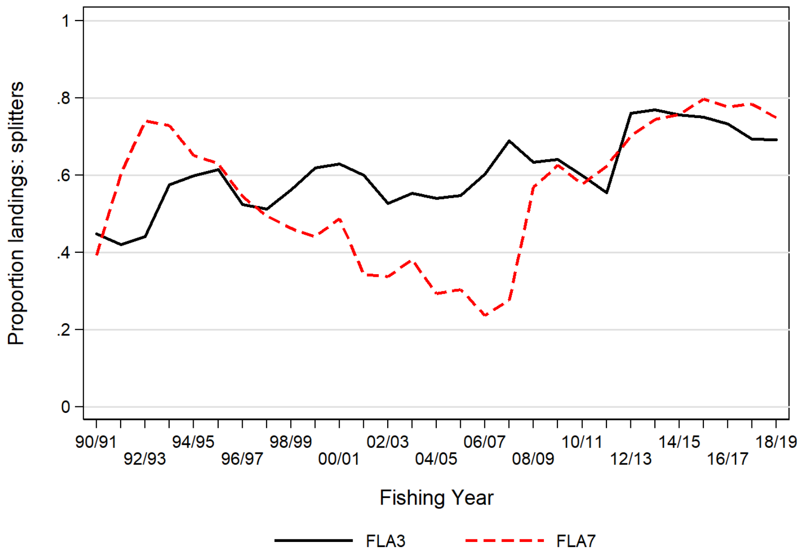


Figure 2: Proportion of annual landings represented by "splitter" trips in FLA 3 and FLA 7, where splitter trips are defined as those which reported FLA landings but did not use the generic FLA code to report estimated catches. FLA 3 annual percentages reported by Starr & Kendrick (2020a) and for FLA 7 by Starr & Kendrick (2020b).

Table 3: Percent flatfish catch by species in FLA 3 and FLA 7 for "splitter" trips, which are trips which landed FLA but which did not use the generic FLA code in the estimated catch section of the catch/effort form. Trip estimated catches by species were scaled to the total FLA landings for the trip and summed for the period 1990–91 to 2018–19 (see Figure 2 for annual time series of splitter trips in FLA 3 and FLA 7).

Species code	Common name	FLA 3 (%)[1]	FLA 7 (%)[2]
BFL	Black Flounder	3.6	0.3
BOT	Lefteyed Flounders	<0.01	0
BRI	Brill	3.0	5.7
ESO	N.Z. Sole	27.6	35.8
GFL	Greenback Flounder	1.3	3.6
LSO	Lemon Sole	43.3	5.4
MAN	Finless Flounder	<0.01	<0.01
SDF	Spotted Flounder	<0.01	0
SFL	Sand Flounder	14.7	33.7
SLS	Slender Sole	<0.01	<0.01
TUR	Turbot	1.3	11.2
WIT	Witch	0.8	0.3
YBF	Yellowbelly Flounder	4.3	3.9

[1]Starr & Kendrick (2020a); [2]Starr & Kendrick (2020b)

1.2 Recreational fisheries

There are important recreational fisheries, mainly for the four flounder species, in most harbours, estuaries, coastal lakes. and coastal inlets throughout New Zealand. The main methods are set netting, drag netting (62.8% combined), and spearing (36.1%) (Wynne-Jones et al 2014). In the northern region, important areas include the west coast harbours, the lower Waikato, the Hauraki Gulf, and the Firth of Thames. In the Bay of Plenty, Ohiwa and Tauranga harbours are important. In the Challenger FMA, there is a moderate fishery in Tasman Bay and Golden Bays and in areas of the Mahau-Kenepuru Sound and in Cloudy Bay. In the South-East and Southland FMAs, flatfish are taken in areas such as Lake Ellesmere, inlets around Banks Peninsula and the Otago Peninsula, the Oreti and Riverton estuaries, Bluff Harbour, and the inlets and lagoons of the Chatham Islands (for further details see the 1995 Plenary Report).

1.2.1 Management controls

The main method used to manage recreational harvests of flatfish are minimum legal sizes (MLS) and daily bag limits. General spatial and method restrictions also apply, particularly to the use of set nets. The flatfish MLS for recreational fishers is 25 cm for all species except sand flounder for which the MLS is 23 cm. Fishers can take up to 20 flatfish as part of their combined daily bag limit in the

Auckland, Central, and Challenger Fishery Management Areas. Fishers can take up to 30 flatfish as part of their combined daily bag limit in the South-East, Kaikoura, Fiordland, and Southland Fishery Management Areas.

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 for flatfish were calculated using an offsite regional telephone/diary survey approach. Estimates for 1996 came from a national telephone-diary survey (Bradford 1998). Another national telephone-diary survey was carried out in 2000 (Boyd & Reilly 2005). 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. 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 collected in standardised phone interviews. The national panel survey was repeated during the 2017–18 fishing year using very similar methods to produce directly comparable results (Wynne-Jones et al 2019). Recreational catch estimates from the two national panel surveys are given in Table 4. Note that national panel survey estimates do not include recreational harvest taken under s111 general approvals.

Table 4: Estimated number and weight of flatfish, by Fishstock and survey, harvested by recreational fishers. Surveys were carried out in different years in the Fisheries regions: South in 1991–92, Central 1992–93, North 1993–94 (Teirney et al 1997) and nationally in 1996 (Bradford 1998) and 1999–00 (Boyd & Reilly 2005). (– Data not available). National panel surveys (Wynne-Jones et al 2014, 2019) were conducted 1 October to 30 September and used mean weights for flatfish from boat ramp surveys (Hartill & Davey 2015, Davey et al 2019).

Fishstock	Survey	Number	CV	Harvest range (t)	Point estimate (t)
1991–92					
FLA 1	South	3 000	–	–	
FLA 3	South	15 200	0.31	50–90	
FLA 7	South	3 000	–	–	
1992–93					
FLA 1	Central	6 100	–	–	
FLA 2	Central	73 000	0.26	20–40	
FLA 7	Central	37 100	0.59	10–30	
1993–94					
FLA 1	North	520 000	0.19	225–275	
FLA 2	North	3 000	–	0–5	
1996					
FLA 1	National	308 000	0.11	95–125	110
FLA 2	National	67 000	0.19	13–35	24
FLA 3	National	113 000	0.14	30–50	40
FLA 7	National	44 000	0.18	10–20	16
1999–00					
FLA 1	National	702 000	0.25	203–336	–
FLA 2	National	380 000	0.49	82–238	–
FLA 3	National	395 000	0.33	128–252	–
FLA 7	National	114 000	0.53	23–73	–
2011–12					
FLA 1	Panel	64 999	0.37	–	27.2
FLA 2	Panel	12 885	0.31	–	5.4
FLA 3	Panel	53 475	0.31	–	21.7
FLA 7	Panel	12 259	0.37	–	4.7
2017–18					
FLA 1	Panel	37 289	0.28	–	15.2
FLA 2	Panel	22 324	0.41	–	9.1
FLA 3	Panel	23 316	0.38	–	9.5
FLA 7	Panel	12 930	0.43	–	5.3

1.3 Customary non-commercial fisheries
Quantitative information on the current level of customary non-commercial catch is not available.

1.4 Illegal catch
There is no quantitative information on the current level of illegal catch available.

1.5 Other sources of mortality
The extent of unrecorded fishing mortality is unknown.

2. BIOLOGY

Some New Zealand flatfish species are fast-growing and short-lived, generally only surviving to 3–4 years of age, with very few reaching 5–6 years. Others, such as brill and turbot, are longer lived, reaching a maximum age of 21 years and 16 years, respectively (Stevens et al 2001). However, these estimates have yet to be fully validated. Size limits (set at 25 cm for most species) are generally at or above the size at which the fish reach maturity and confer adequate protection to the juveniles.

Available biological parameters relevant to stock assessment are shown in Table 5. The estimated parameters in sections 1 and 3 of the table apply only to sand flounder in Canterbury and brill and turbot in west coast South Island — growth patterns are likely to be different for these species in other areas and for other species of flatfish.

Table 5: Estimates of biological parameters for flatfish.

Fishstock	Estimate	Source
1. Natural mortality (*M*)		
Brill - West coast South Island (FLA 7)	0.20	Stevens et al (2001)
Turbot - West coast South island (FLA 7)	0.26	Stevens et al (2001)
Sand flounder - Canterbury (FLA 3)	1.1–1.3	Colman (1978)
Lemon sole - West coast South island (FLA 7)	0.62–0.96	Gowing et al (unpub.)

2. Weight = a(length)^b (Weight in g, length in cm total length).	Females		Males		
	a	b	a	b	
Brill (FLA 7)	0.01443	2.9749	0.02470	2.8080	Hickman & Tait (unpub.)
Turbot (FLA 7)	0.00436	3.3188	0.00571	3.1389	Hickman & Tait (unpub.)
Sand flounder (FLA 1)	0.03846	2.6584	-	-	McGregor et al (unpub.)
Yellowbelly flounder (FLA 1)	0.07189	2.5117	0.00354	3.3268	McGregor et al (unpub.)
New Zealand sole (FLA 3)	0.03578	2.6753	0.007608	3.0728	McGregor et al (unpub.)

3. von Bertalanffy growth parameters	Females			Males			
	L_∞	k	t_0	L_∞	k	t_0	
Brill							
West coast South Island (FLA 7)	43.8	0.10	–15.87	38.4	0.37	38.4	Stevens et al (2001)
Turbot							
West coast South island (FLA 7)	57.1	0.39	0.30	49.2	0.34	49.2	Stevens et al (2001)
Sand flounder							
Canterbury (FLA 3)	59.9	0.23	–0.083	37.4	0.781	37.4	Mundy (1968), Colman (1978)
Lemon sole							
West coast South island (FLA 7)	26.1	1.29	–0.088	25.6	1.85	25.6	Gowing et al (unpub.)
Greenback flounder (FLA 5)	55.82	0.26	–1.06	52.21	0.25	–1.32	Sutton et al (2010)

Sutton et al (2010) undertook an age and growth analysis of greenback flounder. That analysis showed that growth is rapid throughout the lifespan of greenback flounder. Females reached a slightly greater maximum length than males, but the difference was not significant at the 95% level of confidence. Over 90% of sampled fish were 2 or 3 years of age, with maximum ages of 5 and 10 years being obtained for male and female fish respectively. This difference in maximum age resulted in estimated natural mortalities using Hoenig's (1983) regression method, of 0.85 for males and 0.42 for females. It is suggested that 0.85 is the most appropriate estimate at this stage because only 1% of all fish exceeded 5 years. However, it was also noted that a complete sample of the larger fish was not obtained and as a result these estimates should be considered preliminary. Growth rings were not validated.

Flatfish are shallow-water species, generally found in waters less than 50 m depth. Juveniles congregate in sheltered inshore waters, e.g., estuarine areas, shallow mudflats, and sandflats, where they remain for up to two years. Juvenile survival is highly variable. Flatfish move offshore for first spawning at 2–3 years of age during winter and spring. Adult mortality is high, with many flatfish spawning only once and few spawning more than two or three times. However, fecundity is high, e.g., from 0.2 million eggs to over 1 million eggs in sand flounders.

3. STOCKS AND AREAS

There is evidence of many localised stocks of flatfish. However, the inter-relationships of adjacent populations have not been well studied. The best information is available from studies of the variation in morphological characteristics of sand flounders and from the results of tagging studies, conducted mainly on sand and yellowbelly flounders. Variation in morphological characteristics indicate that sand flounder stocks off the east and south coasts of the South Island are clearly different from stocks in central New Zealand waters and from those off the west coast of the South Island. There also appear to be differences between west coast sand flounders and those in Tasman Bay, and between sand flounders on either side of the Auckland-Northland peninsula. Tagging experiments show that sand flounders, and other species of flounder, can move substantial distances off the east and south coasts of the South Island. However, fish tagged in Tasman Bay or the Hauraki Gulf have never been recaptured very far from their point of release.

Thus, although the sand flounders off the east and south of the South Island appear to be a single, continuous population, fish in enclosed waters may be effectively isolated from neighbouring populations and should be considered as separate stocks. Examples of such stocks are those in Tasman Bay and the Hauraki Gulf and possibly areas such as Hawke Bay and the Bay of Plenty.

There are no new data which would alter the stock boundaries used in previous assessment documents.

4. STOCK ASSESSMENT

4.1 Estimates of fishery parameters and abundance

FLA 1

Four standardised CPUE series have been used to track FLA 1 abundance (Kendrick & Bentley 2011; Kendrick & Bentley 2012), which were updated again in 2015 (Kendrick & Bentley in prep.), using estimated catches as the dependent variable:

1. FLA+YBF in Manukau Harbour (Statistical Area 043);
2. FLA+YBF in Kaipara Harbour (Statistical Area 044);
3. YBF in Hauraki Gulf (Statistical Areas 005, 006, and 007);
4. SFL in Hauraki Gulf (Statistical Areas 005, 006, and 007).

These series were again updated in 2018 with an additional three years of data (Starr & Kendrick 2019b), based on estimated catches as well as using a procedure (termed “F2”) which scales estimated catches to landings using a “vessel correction factor”. This procedure multiplies estimated catches with the ratio of landings to estimated catches for a vessel in a fishing year. A comparison of the two series showed no material difference in output between the two procedures, even though the F2 procedure truncates the data set to avoid excessively large and small ratios. Starr & Kendrick (2019b) also summed all flatfish estimated catches for the Manukau Harbour and Kaipara Harbour analyses to create a TOT category. This was done because estimated catches of other flatfish species are negligible in these harbours (Table 6) and a comparison with 2015 series showed no difference in the overlapping years. The Northern Inshore Working Group accepted series 1, 2, and 3 (above) as reflecting abundance. However, the SFL series in the Hauraki Gulf was rejected by the NINSWG because it was noted that the reporting of SFL in the estimated catches fell away in the early to mid-2000s which was also a period when the SFL CPUE dropped while, at the same time, there was little change in the species-specific reporting of YBF. This trend in the reporting pattern for SFL makes the associated CPUE series unreliable, resulting in a recommendation that the SFL series be replaced with a TOT series (which sums all flatfish species catch).

Less than half of the estimated FLA 1 flatfish catch in each year was identified by species (Table 6), but most of the flatfish caught in FLA 1 West were likely to be yellowbelly flounder under the assumption that the flatfish reported using the generic "FLA" code are YBF. This assumption is supported by the fact that the preferred muddy bottom habitat of yellowbelly flounder dominates the west coast harbours. Over 80% of the west coast catch is taken from Kaipara Harbour and Manukau Harbour (Table 6). Standardised CPUE trends were derived for these two areas using TOT (sum of all flatfish estimated catches) or the F2 procedure applied to the TOT estimated catches (upper panels, Figure 3). In spite of fluctuations, both the Manukau and Kaipara series show a long-term declining trend and are currently 68% and 65% below the respective peaks in the early to mid-1990s (upper panels, Figure 3). Work by NIWA (McKenzie et al 2013) in the Manukau Harbour has linked the decrease in local CPUE with an increase in eutrophication, suggesting that there may be factors other than fishing contributing to the decline.

Table 6: Total FLA 1 estimated catches by declared flatfish species, summed over the period 1989–90 to 2016–17.

	Manukau	Kaipara	Lower Waikato	Northwest	FLA 1 West	East Northland	Hauraki Gulf	Bay of Plenty	FLA 1 East	Total FLA 1
FLA	1 876.2	2 682.4	543.9	523.1	5 625.6	565.3	3 097.1	264.3	3 926.7	9 552.3
YBF	127.4	1 661.8	96.6	163.5	2 049.3	401.9	2 510.9	133.4	3 046.2	5 095.5
SFL	3.9	44.0	18.5	8.7	75.1	58.2	1 198.5	308.0	1 564.7	1 639.8
ESO	0.0	0.0	10.8	16.1	26.9	1.1	5.4	204.7	211.2	238.1
GFL	0.0	0.1	7.5	0.2	7.8	0.0	202.6	12.7	215.3	223.1
LSO	0.0	0.0	1.2	2.4	3.6	0.5	1.0	76.8	78.3	81.9
BRI	0.0	0.0	7.4	2.6	10.0	0.1	0.1	19.5	19.7	29.7
BFL	0.0	0.0	0.1	0.2	0.3	0.3	26.3	2.3	28.9	29.2
TUR	0.0	0.0	4.3	4.4	8.7	0.1	0.3	1.2	1.6	10.3
Total	2 007.5	4 388.2	690.4	721.3	7 807.4	1 027.6	7 042.2	1 022.7	9 092.5	16 899.9

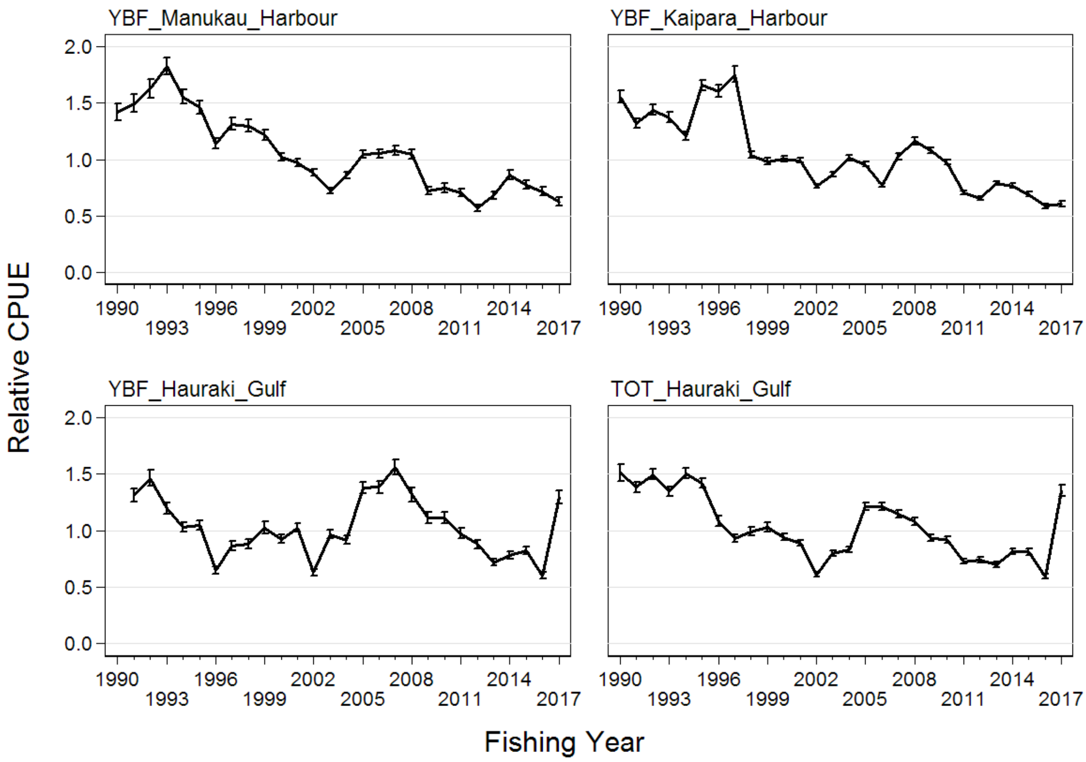


Figure 3: Standardised CPUE indices for yellowbelly flounder from models of catch rate in successful set net trips in Manukau Harbour, Kaipara Harbour (YBF assumed), and in the Hauraki Gulf (YBF reported). Also shown is the series for total FLA in Hauraki Gulf. All models based on estimated catches scaled by a "vessel correction factor" (F2 procedure).

Seventy-seven percent of the flatfish catch from FLA 1 East, including a substantial and variable proportion of sand flounder, is taken in the Hauraki Gulf, particularly from the Firth of Thames (Area 007). Separate indices were calculated for sand and yellowbelly flounder in Statistical Areas 005 to 007, and the portion of FLA catch not identified by species was excluded. However, the SFL series was not accepted by the NINSWG in 2018 (see above for rationale) and a FLA(TOT) series was prepared instead. The Hauraki Gulf yellowbelly CPUE index peaked in 2006–07 and then declined steadily to 2015–16. However, there was a sharp upturn in the YBF series in 2016–17, with the final index returning to above the series mean (lower left panel, Figure 3). A total FLA series for the Hauraki Gulf was created to replace the rejected sand flounder index in the same region (lower right panel, Figure 3). This series shows an overall declining trend except for a three-year increase from 2002 to 2005 and a single strong increase in the final 2017 fishing year, which brings the series above the long-term average.

FLA 2

In 2017, Schofield et al (2018a) provided standardised CPUE for FLA 2 (Figure 4) based on the flatfish target fishery in Statistical Areas 013 and 014. Estimated catches were allocated to daily aggregated effort using methodology described by Langley (2014) to improve the comparability between the data collected from two different statutory reporting forms (CELR and TCER). A core fleet of 15 vessels that had completed at least five trips per year in at least seven years was identified. The model, using a gamma error distribution, adjusted for changes in duration, month, and vessel, accounted for 33% of the variance in catch. Area was not included in the model because the change in reporting forms appears to have influenced the catch split between areas 013 and 014.

The NINS WG noted that most of the records in the aggregated data had catches of flatfish and that a binomial index was flat. As a result the positive catch index was retained as the key monitoring series. The CPUE series exhibits moderate fluctuations around the long-term mean, with no overall trend up or down and appears currently to be in an increasing phase.

Characterisation using the estimated catch data suggests that the FLA 2 catch comprises mainly sand flounder (SFL) and New Zealand sole (ESO). CPUE indices for ESO and SFL were provided by Schofield et al (2018a) for 2008 to 2016 using the tow by tow data from vessels consistently estimating catches by flatfish species. Trends were apparent in the probability of catch, so combined (binomial and positive catch modelled with a gamma distribution) indices were produced. There is reasonable consistency between the species-specific indices and the overall FLA 2 index (Figure 4), noting that — because the FLA 2 fishery is small — the datasets for the individual species are small and the indices variable.

These indices were updated in 2018 (Schofield et al 2018b) to include data to 30 September 2017.

Establishing B_{MSY} compatible reference points

In 2014, the Working Group adopted mean CPUE from the bottom trawl flatfish target series for the period 1989–90 to 2012–13 as a B_{MSY}-compatible proxy for FLA 2. The Working Group accepted the default Harvest Strategy Standard definitions that the Soft and Hard Limits would be one half and one quarter the target, respectively.

FLA 3

CPUE trends

CPUE trends for the three principal FLA 3 species (New Zealand sole [ESO], sand flounder [SFL] and lemon sole [LSO]) and an aggregated catch landed to FLA [TOT], based on bottom trawl catch and effort data, were updated in 2020 (Starr & Kendrick 2020a). The species-specific catch data were based on "splitter" trips, defined as trips which landed FLA 3 but which did not use the FLA code in the estimated catch section of the catch/effort form. Alternative definitions of "splitters" based on vessel performance were investigated in 2015 (Starr & Kendrick 2018), but CPUE trends were found to be similar to those derived from the "trip splitter" algorithm. The latter was selected because it retained the greatest amount of catch, particular in the early years of the series.

The CPUE data were prepared by matching the FLA landing data for a trip with the effort data from the same trip that had been amalgamated to represent a day of fishing. The procedure assigns the modal statistical area and modal target species (defined as the observation with the greatest effort) to the trip/date record. All estimated catches for the day were summed and the five top species with the greatest catch were assigned to the date. This "daily-effort stratum" preparation method was followed so that the event-based data forms that are presently being used in these fisheries can be matched as well as possible with the earlier daily forms to create a continuous CPUE series. For this procedure to function correctly, given that there are multiple flatfish species in the estimated catches, the matching procedure with landings is done twice: first by summing all flatfish estimated catches into a single generic "flatfish" category. The ratio of the total FLA landings relative to the sum of the estimated flatfish catches can then be used to scale each of the species-specific estimated catches on the same trip as the second step.

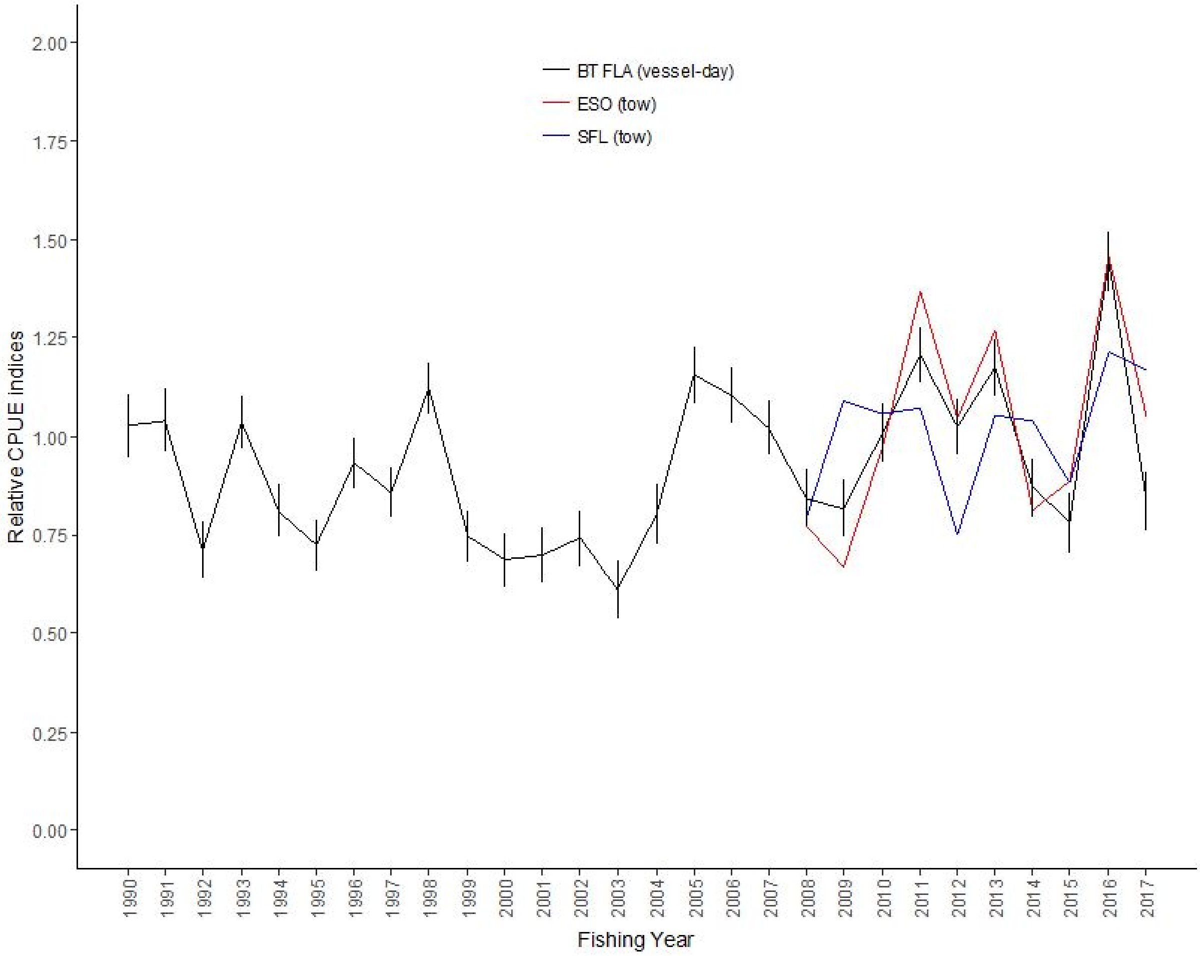


Figure 4: Standardised CPUE indices in FLA 2 for BT targeting all species of flatfish, (aggregated to combine data across form types, BT_flats(day)), and shorter combined series for sand flounder (BT_sfl(tow)) and New Zealand sole (BT_eso(tow)) based on tow by tow resolution data (Schofield et al 2018b).

Each analysis was confined to a set of core vessels which had participated consistently in the fishery for a reasonably long period (5 trips for at least 5 years). The explanatory variables offered to each model included fishing year (forced), month, vessel, statistical area, number tows, and duration of fishing, with the scaled estimated species catch used as the dependent variable. The WG agreed to report only the lognormal series for these analyses because zero records only meant that the species had not been reported, rather than being a true zero. The WG also agreed to restrict all analyses to target FLA records and to the following six statistical areas: 020, 022, 024, 026, 025, and 030.

The estimated CPUE trends by species were used to evaluate the relative status of the three main species in the FLA 3 fishery. The generic FLA series was used to drive an MP by estimating the CPUE for the terminal year based on early harvest returns for the fishery (see description below). There were similarities among the three species-specific standardised CPUE indices (Figure 4), with all indices increasing in the early 1990s and peaking at some point in the early to mid-1990s. All indices then have a trough in the early- to mid-2000s, followed by an increase for LSO and SFL and a decrease for ESO, with the ESO and SFL indices showing similarity in their fluctuations. The LSO index had its peak in the 1990s; i.e., later than the other indices, and increased sooner than the other species in the mid-2000s (Figure 4). The SFL index has increased and then levelled out, whereas the other two indices have dropped from peaks reached in 2009–10.

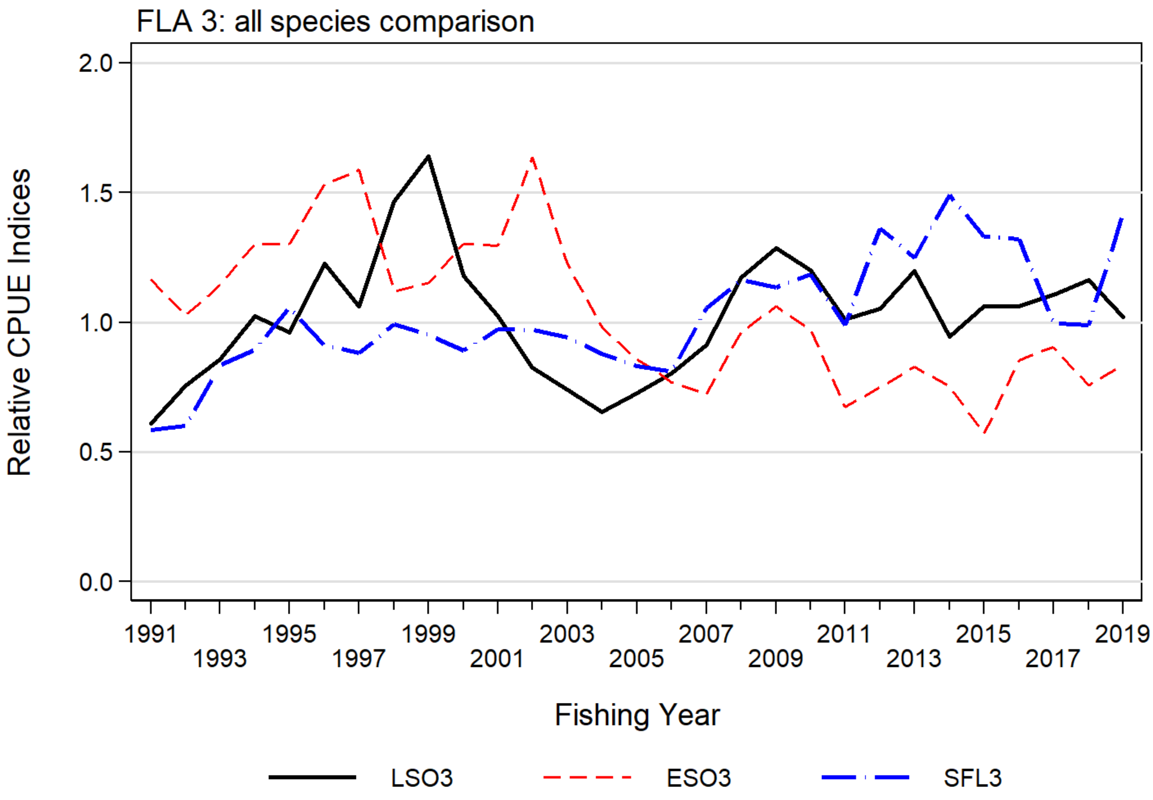


Figure 5: Comparison of standardised bottom trawl lognormal CPUE indices in FLA 3 for LSO (lemon sole), ESO (New Zealand sole), and SFL (sand flounder) (from Starr & Kendrick 2020a).

ECSI trawl survey biomass estimates for LSO, ESO, and SFL

Lemon sole biomass indices in the core strata (30–400 m) from the east coast South Island trawl survey (Table 7) show no trend (Figure 6). Coefficients of variation are moderate to low, ranging from 15 to 33% (mean 23%). The additional biomass captured in the 10–30 m depth range region accounted for 1% to 5% of the biomass in the core plus shallow strata (10–400 m) for the five years with usable biomass estimates in the 10–30 m region, indicating that the existing core strata time series in 30–400 m are more important for this species. A comparison of the LSO CPUE series with the LSO ECSI biomass indices shows that both series fluctuate without trend and show considerable variation (Figure 6). The correspondence between the two sets of indices is weak (rho=-0.342; R^2=12%).

The shallow 10–30 m region holds a substantial fraction of the biomass of the other two important FLA 3 species, ESO and SFL. This fraction ranges from 54–90% of the total annual ESO biomass whereas the equivalent range for SFL is 41–96% (Table 7). There is reasonable correspondence between the summed survey biomass estimates and the equivalent commercial CPUE series over the five overlapping years (Figure 7), although the CVs for these estimates are large for both species (Table 7).

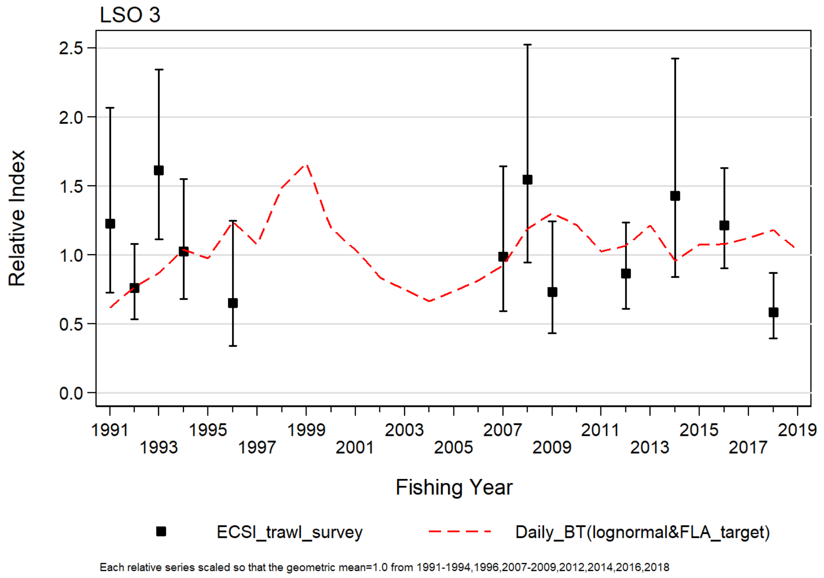


Figure 6: Lemon sole total biomass and 95% confidence intervals for the ECSI winter survey in core strata (30–400 m) plotted against the LSO bottom trawl CPUE series.

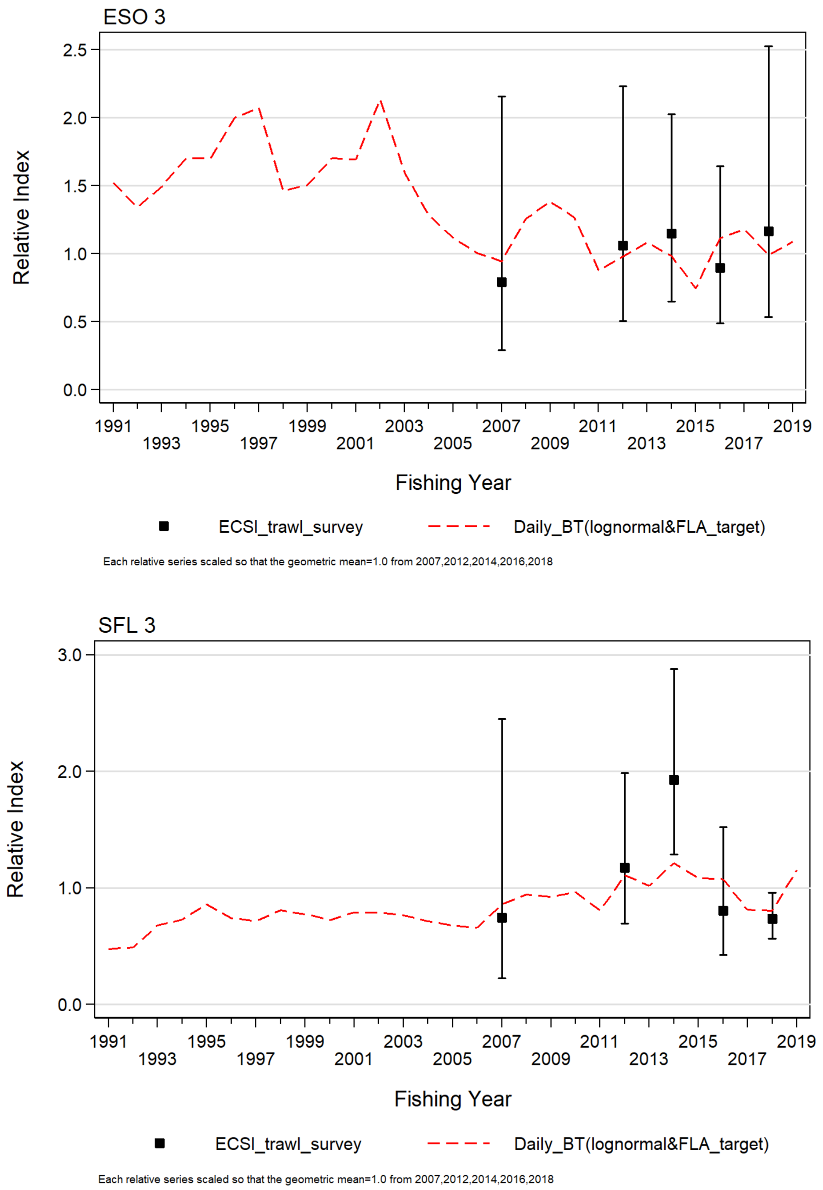


Figure 7: New Zealand sole (ESO: top panel) and sand flounder (SFL: bottom panel) total biomass and 95% confidence intervals for the summed ECSI winter survey core + shallow strata plotted against the respective ESO and SFL bottom trawl CPUE series.

Table 7: Relative biomass indices (t) and coefficients of variation (CV) for lemon sole (LSO). New Zealand sole (ESO) and sand flounder (SFL) from the east coast South Island (ECSI) - winter survey area. Biomass estimates are provided for the core (30–400 m) region and for the shallow (10–30 m) region introduced in 2007. NA: insufficient tows for shallow region.

Species	Year	Trip number	Total Biomass estimate (t)	CV (%)	Total Biomass estimate (t)	CV (%)
			30–400 m (core)		10–30 m	
LSO	1991	KAH9105	92	27	–	–
	1992	KAH9205	57	18	–	–
	1993	KAH9306	121	19	–	–
	1994	KAH9406	77	21	–	–
	1996	KAH9606	49	33	–	–
	2007	KAH0705	74	26	3	38
	2008	KAH0806	116	25	NA	NA
	2009	KAH0905	55	27	NA	NA
	2012	KAH1207	65	18	1	55
	2014	KAH1402	107	27	2	50
	2016	KAH1605	91	15	3	52
	2018	KAH1803	44	20	2	33
ESO	2007	KAH0705	5	51	19	72
	2008	KAH0806	6	38	NA	NA
	2009	KAH0905	2	48	NA	NA
	2012	KAH1207	15	82	17	38
	2014	KAH1402	13	41	22	29
	2016	KAH1605	4	64	23	31
	2018	KAH1803	3	60	32	40
SFL	2007	KAH0705	16	61	31	64
	2008	KAH0806	9	52	NA	NA
	2009	KAH0905	2	74	NA	NA
	2012	KAH1207	43	71	30	27
	2014	KAH1402	55	42	65	21
	2016	KAH1605	2	63	48	33
	2018	KAH1803	5	99	40	14

In-season Management Procedure

In 2007 concerns were expressed about the sustainability of FLA 3 catches and the TACC was reduced from 2681 t to 1430 t from 1 October 2007. In the 2008–09 fishing year anecdotal information indicated an increase in abundance of lemon and New Zealand sole in the FLA 3 QMA above a level that fishers were able to utilise within the available TACC. It was considered that there was opportunity for increased utilisation that would not adversely impact on the long-term sustainability of the FLA 3 stock complex and for 2008–09 ‘in-season’ commercial allowances were set at 1780 t based on the 15 year average of commercial FLA3 catches.

In 2010, an ‘in-season’ Management Procedure (MP) was developed which has been used to inform in-season adjustments to the FLA 3 TACC since 2010–11 (Bentley 2009, 2010). This MP was updated and revised in 2015 (Starr et al 2018). It used the relationship between annual standardised CPUE for all FLA 3 species (shown as FLA in Figure 5) and the total annual FLA 3 landings to estimate an average exploitation rate which is then used to recommend a level of full-season catch based on an early estimate of standardised CPUE. Only the period 1989–90 to 2006–07 was used to estimate the average exploitation rate because this was the period before the TACC was reduced which allowed the fishery to operate at an unconstrained level. A partial year in-season estimate of standardised CPUE is used as a proxy for the final annual index, with the recommended catch defined by the slope of the regression line (Figure 8) multiplied by the CPUE proxy estimate (Figure 8 shows the outcome of this procedure for 2019).

The 2010 FLA 3 MP approximated the standardisation procedure by applying fixed coefficients to a data set specified by a static core vessel definition. This approach deteriorated over time as vessels dropped out of the core vessel fleet, thus reducing the available data set. The 2015 MP was based on a re-estimated standardisation procedure using a data set specified annually by a dynamic core vessel definition, allowing new vessels to enter the data set as they meet the minimum eligibility criteria. The 2015 MP was validated through a retrospective analysis which used the data available up to end of the previous year and the partial data in the final year to determine how the model performed across years (Figure 9). In most years, the MP performance was satisfactory after only two months of data were accumulated. The poor performance of the model in some years (e.g., 2012) persisted across all four early months, indicating that collecting additional data in those years would not have improved the recommendation (relative to the end of year recommendation).

Starr & Kendrick (2020a) repeated the 2015 evaluation of the capacity of the FLA 3 MP to estimate the final annual CPUE, given the accumulation of two to five months of data in the final (predictive) year. This evaluation was made retrospectively over 12 years of observations from 2007–08 to 2018–19, using partial year data to estimate the annual CPUE in the final year. They showed that the first two months of data (October, November) had an average absolute prediction error of 11% (range: 4.7% to 23.1%). This statistic dropped by less than 1% with the addition of data from the month of December and by less than another 2% after the addition of the January data. This relative insensitivity to adding additional months of data to the analysis indicates that the MP should be able to provide benefit to the fishery once the implementation difficulties are solved.

Table 8 shows the results of the operation of the FLA 3 in-season MP since the inception of the Schedule 2 programme. Five TACC in-season increases have been recommended since 2010 based on the operation of the MP (2009–10, 2010–11, 2012–13, 2015–16, and 2016–17; Table 8). However, MPI approval of the 2016–17 increase was delayed until late August, resulting in limited opportunity to take advantage of the increase in commercial catch allowance. The FLA 3 MP was suspended by Fisheries New Zealand from 2019–20 due to the long delays which are consequent to the consultation requirements attendant to catch limit changes, even if they are temporary. These delays resulted in reduced (or even eliminated) opportunities to catch the additional flatfish.

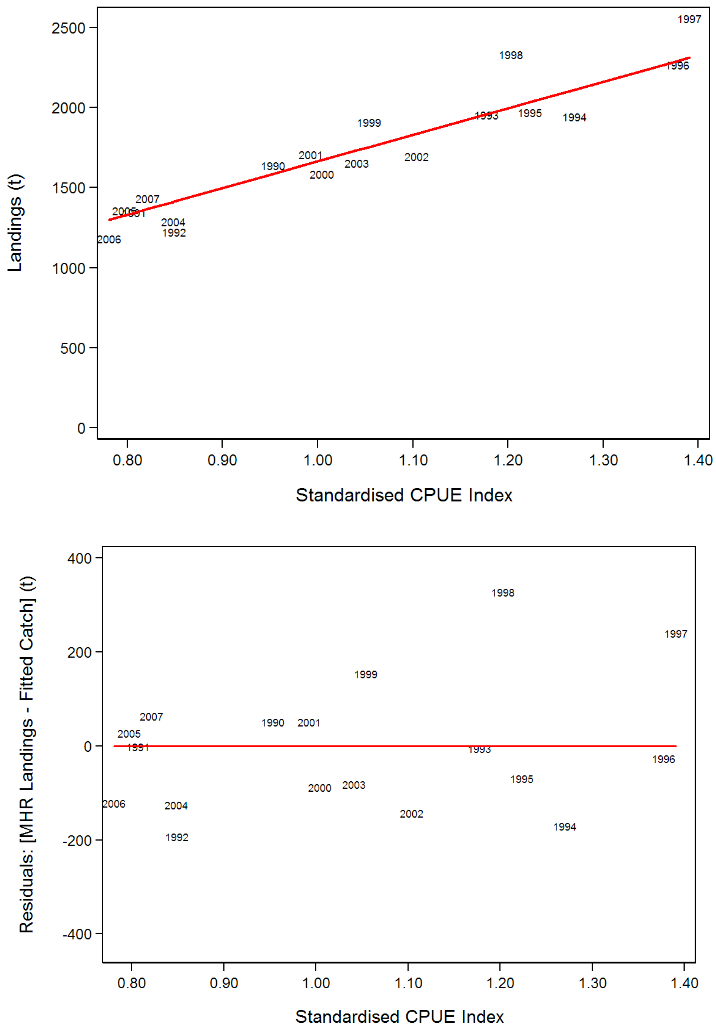


Figure 8: [top panel] Relationship between annual FLA 3 CPUE and total annual FLA 3 QMR/MHR landings from 1989–90 to 2006–07 (calculated for the 2019 in-season MP, the most recent year of the operation of this MP); [bottom panel] residuals from the left panel regression.

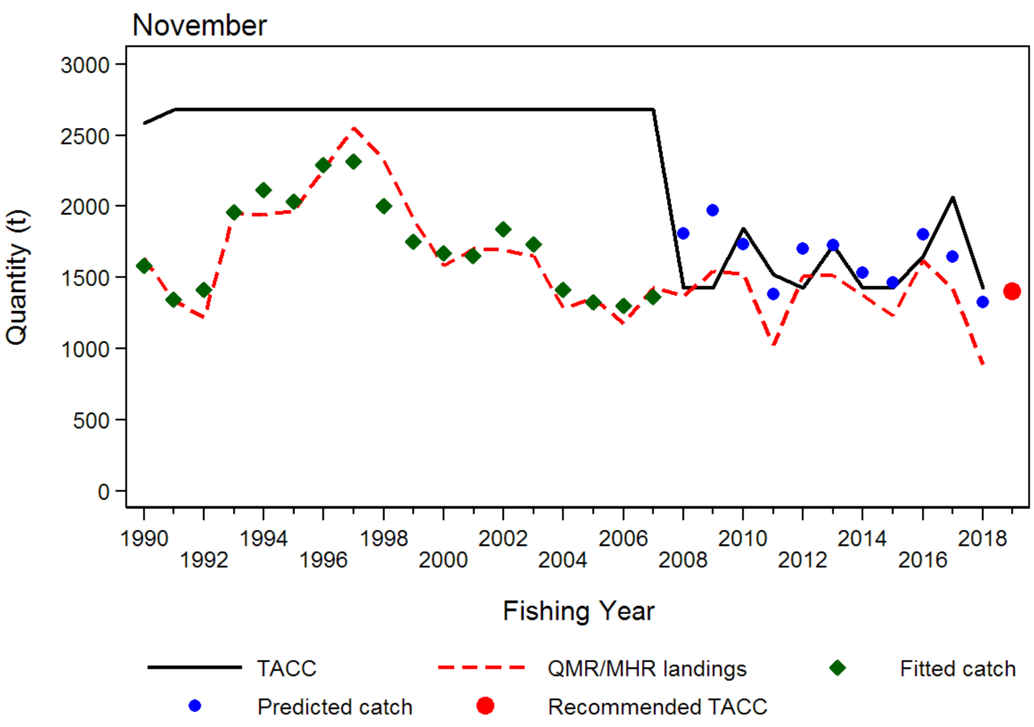


Figure 9: Operation of the 2015 FLA 3 MP in 2019 (the most recent year of operation), showing the relationship of the fitted catch estimates to the observed MHR/QMR landings and the annual recommended catches from 2008 onward based on the estimated standardised CPUE up to the end of November.

Table 8: Results of the operation of the FLA 3 MP by prediction year. NA: not available.

Prediction Year	Fishing Year	CPUE Prediction	CPUE Total year[1]	Recom-mended commercial allowance	Approved commercial allowance (t)[2]	Annual catch (t)	Date of Approval[2]	Reference
2010*	2009–10	64.98 (kg/tow)	75.82	1 846	1 763	1 525	18 June 2010	Bentley (2010)
2011*	2010–11	59.83 (kg/tow)	58.76	1 520	1 430	1 027	–	Bentley (2011)
2012	2011–12	58.45 (kg/tow)	57.56	1 495	–	1 507	–	Bentley (2012)
2013*	2012–13	67.97 (kg/tow)	69.70	1 727	1 727	1 512	17 May 2013	Brouwer (2013)
2014	2013–14	NA	54.80	NA	–	1 377	–	NA
2015	2014–15	53.20 (kg/tow)	NA	1 362	1 352	1 231	–	Bentley (2015)
2016*	2015–16	0.984	1.048	1 650	1 650	1 622	15 July 2016	Starr et al (2016)
2017*	2016–17	1.215	0.978	2 065	2 065	1 421	23 Aug 2017	Starr & Kendrick (2017)
2018	2017–18	0.870	0.796	1 461	–	886	–	Starr & Kendrick (2018)
2019	2018–19	0.843	0.803	1 402	1 430	968	–	Starr & Kendrick (2019a)

[1] calculated in the year following
[2] information provided by MPI
* MP operation that resulted in a commercial catch allowance increase recommendation

Establishing B_{MSY} compatible reference points

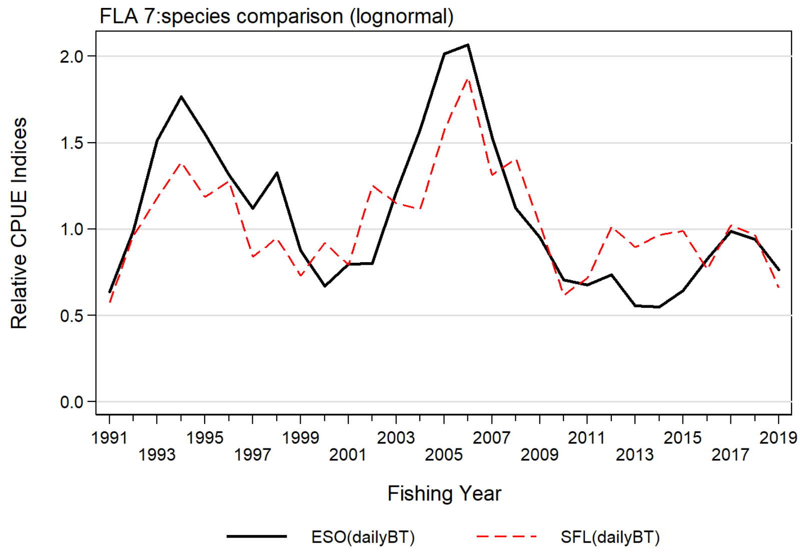
Given the large recruitment driven fluctuations in biomass observed for FLA, a target biomass is not meaningful. In-season adjustments are therefore based on relative fishing mortality for all FLA species combined, with increases made when this drops below the target value. F_{msy} proxies accepted for FLA 3 are the relative fishing mortality values calculated by dividing the baseline TACCs by the corresponding CPUE values on the landings:CPUE regressions shown in Figure 8.

FLA 7

CPUE trends

CPUE trends for four principal FLA 7 species (New Zealand sole [ESO], sand flounder [SFL], brill [BRI], and turbot [TUR]), based on bottom trawl catch and effort data, were estimated in 2020 (Starr & Kendrick 2020b). The data preparation description given for FLA 3 [above] also applies to FLA 7, including the use of "splitter" trips to estimate the time sequences of catch by species, the "daily effort" amalgamation procedure, and scaling all a species-specific catches to the total FLA landings in a trip. The same criteria were used to select core vessels (5 trips for at least 5 years) to screen data used in the analysis which consisted of offering six explanatory variables to each model, including fishing year (forced), month, vessel, statistical area, number of tows, and duration of fishing, using the scaled estimated species catch for the dependent variable. The WG agreed to report only the lognormal series for these species-specific analyses because zero records only meant that the species had not been reported, rather than being a true zero. The WG also agreed to restrict the analyses to target FLA records and to the following spatial restrictions: [SFL]: Tasman Bay/Golden Bay (Area 038); [ESO, BRI, TUR]: west coast South Island (Areas 032, 033, 034 and 035).

The estimated CPUE trends by species were used to evaluate the relative status of the four main species in the FLA 7 fishery. There are similarities in the fluctuations in the standardised CPUE series for ESO and SFL (Figure 10 [left panel]), with each species showing approximate decadal periodicity. They peak three times in the early- to mid-1990s, in the mid-2000s and finally at the end of the 2010s. The final "peak" is low relative to the two previous peaks, indicating that both these species are likely to be at below average levels at the end of the 2010–2019 decade (Figure 10 [left panel]). The more long-lived brill and turbot (Figure 10 [right panel]) show a nadir in the late-1990s to early 2000s, followed by an increasing trend and subsequent levelling of the series. Brill appear to be more ascendant at the end of the series when brill have the highest indices in the series, whereas turbot appears to be declining at the end of the 2010–2019 decade (Figure 10 [right panel]).



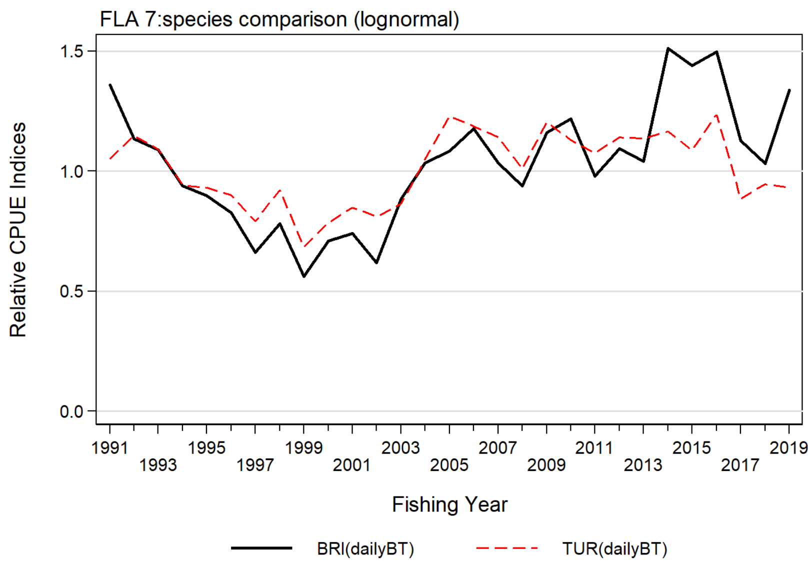


Figure 10: Comparison of FLA 7 standardised bottom trawl lognormal CPUE indices in FLA 7 for [top panel] SFL (sand flounder), ESO (New Zealand sole) [bottom panel] BRI (brill), TUR (turbot) (from Starr & Kendrick 2020b).

Establishing B_{MSY} compatible reference points
The WG discussed establishing B_{MSY} proxy reference points for the four FLA 7 species with CPUE index series. Given that there appeared to be about three decadal cycles in the ESO/SFL series (see Figure 10 [left panel]), the WG agreed to use the average over the entire series as the target. The same conclusion was made for turbot (Figure 10 [right panel]), given that this series appeared to be relatively stable across the 30 years of the time series, making the average of the series the B_{MSY} reference level. The B_{MSY} proxy for brill was based on mean standardised CPUE from 1990–91 to 2018–19(Figure 10 [right panel]), which corresponded with a stable period of high abundance and catch.

4.2 Other Factors

The flatfish complex is comprised of QMS eight species although typically only a few are dominant in any one QMA and some are not found in all areas. For management purposes all species are combined to form a unit fishery. The proportion that each species contributes to the catch is expected to vary annually. It is not possible to estimate *MCY* for each species and stock individually.

Because the adult populations of most species generally consist of only one or two year classes at any time, the size of the populations depends heavily on the strength of the recruiting year class and is therefore thought to be highly variable. Brill and turbot are notable exceptions with the adult population consisting of a number of year classes. Early work revealed that although yellowbelly flounder are short-lived, inter-annual abundance in FLA 1 was not highly variable, suggesting that some factor, e.g. size of estuarine nursery area, could be smoothing the impact of random environmental effects on egg and larval survival. Work by NIWA (McKenzie et al 2013) in the Manukau harbour has linked the decrease in local CPUE with an increase in eutrophication, suggesting that there may be factors other than fishing contributing to the decline.

Flatfish TACCs were originally set at high levels so as to provide fishers with the flexibility to take advantage of the perceived variability associated with annual flatfish abundance. This approach has been modified with an in-season increase procedure for FLA 3.

5. STATUS OF THE STOCKS

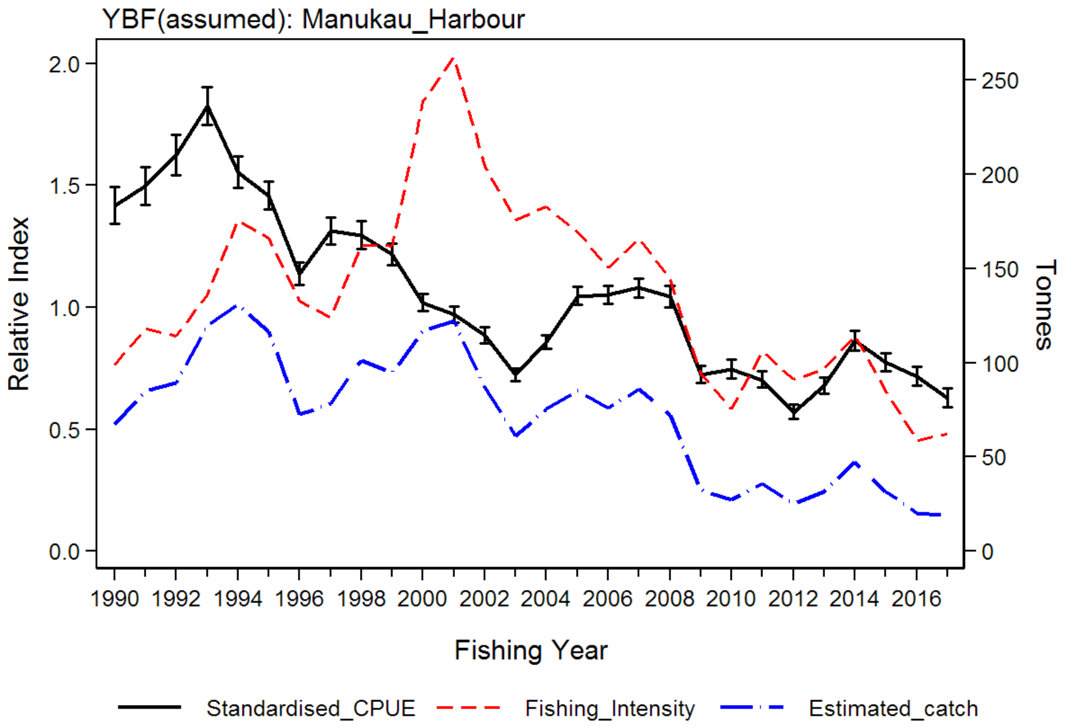
Estimates of current and reference biomass are not available.

- **Yellowbelly flounder in FLA 1**

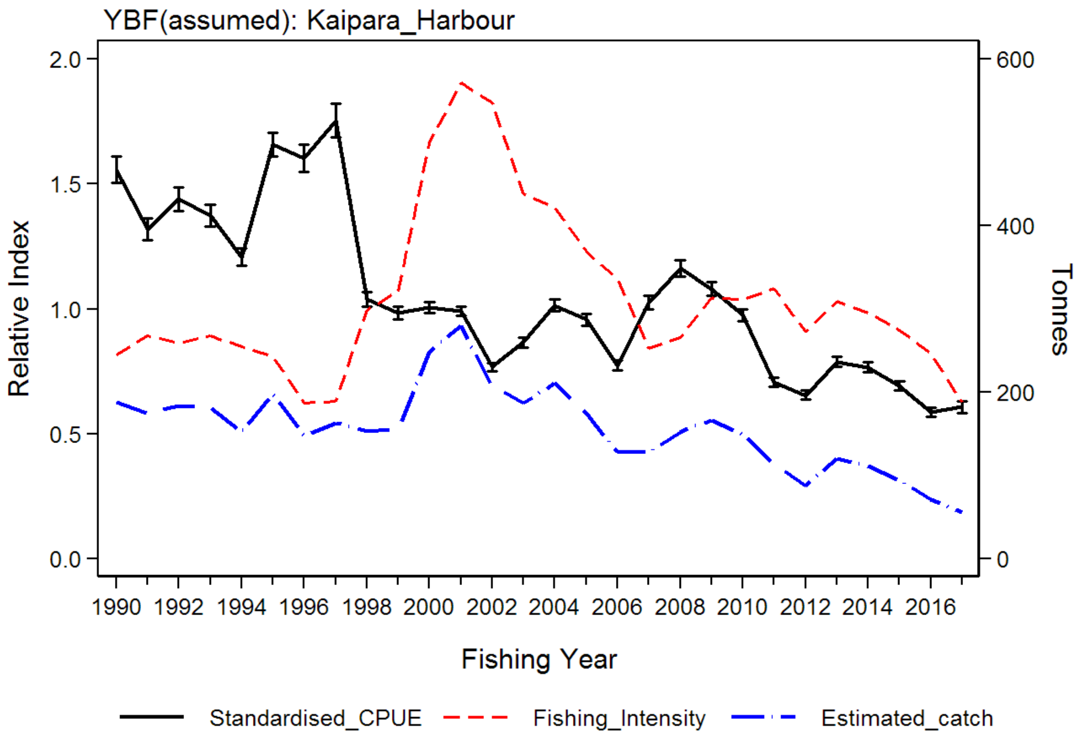
Stock Structure Assumptions
Based on tagging studies, yellowbelly flounder appear to comprise localised populations, especially in enclosed areas such as harbours and bays.

Stock Status	
Year of Most Recent Assessment	2018
Assessment Runs Presented	CPUE in Manukau and Kaipara harbours, and the Hauraki Gulf
Reference Points	Target: Not established but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing Threshold: F_{MSY}
Status in relation to Target	Manukau: Unknown Kaipara: Unknown Hauraki Gulf: Unknown
Status in relation to Limits	Unknown
Status in relation to Overfishing	Unknown

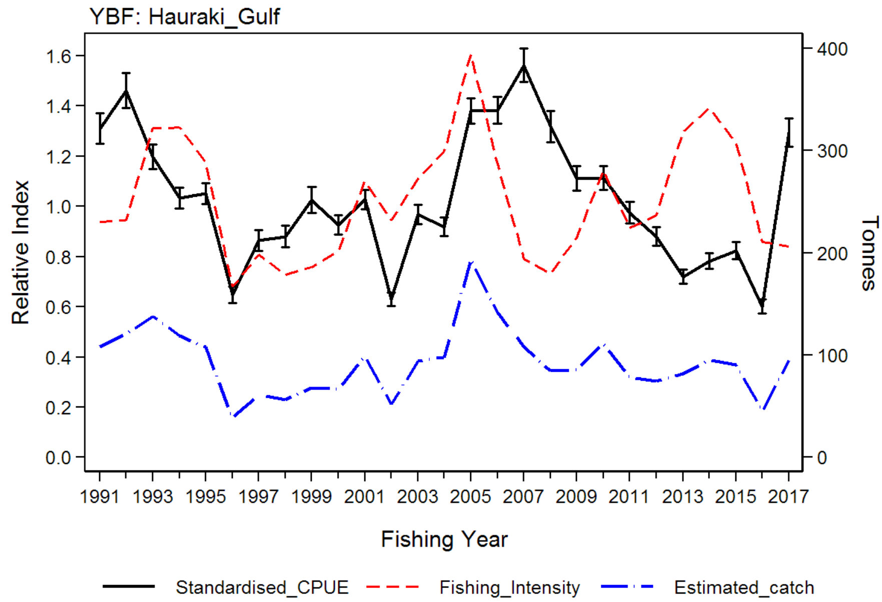
Historical Stock Status Trajectory and Current Status



CPUE and total annual estimated catches for YBF in Manukau Harbour. Also shown is the fishing intensity (catch/CPUE), standardised relative to the geometric mean. Fishing year designated by second year of the pair.



CPUE and total annual estimated catches for YBF in Kaipara Harbour. Also shown is the fishing intensity (catch/CPUE), standardised relative to the geometric mean. Fishing year designated by second year of the pair.



CPUE and total annual estimated catches for YBF in the Hauraki Gulf. Also shown is the fishing intensity (catch/CPUE), standardised relative to the geometric mean. Fishing year designated by second year of the pair.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	In spite of fluctuations, both the Manukau and Kaipara series show a long-term declining trend. The Hauraki Gulf yellowbelly CPUE index has fluctuated, peaking in 2006–07 at the highest point in the series and then declining steadily to 2015–16. However, there was a strong upturn in the final year of the series, with the 2016–17 index returning to above the series mean.
Recent Trend in Fishing Intensity or Proxy	Recent fishing intensity is relatively low in both of the west coast harbours while it sits near the series mean in the Hauraki Gulf series.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unknown
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2018	Next assessment: 2021
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- Uncertainty in the stock structure and relationship between CPUE and biomass	

Qualifying Comments
Work by NIWA (McKenzie et al 2013) in the Manukau harbour has linked the decrease in local CPUE with an increase in eutrophication, suggesting that there may be factors other than fishing contributing to the decline. The lack of species specific reporting for FLA stocks is limiting the ability to assess these stocks, as is the possible reduction in carrying capacity for Manukau and Kaipara Harbours.

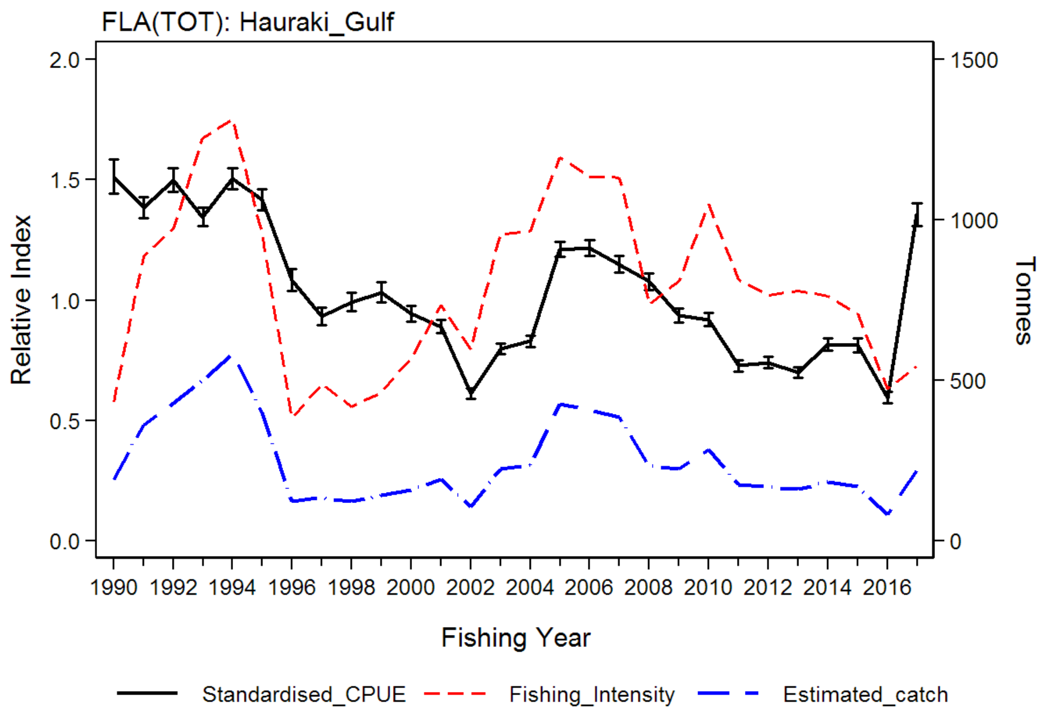
Fishery Interactions
Main bycatch is sand flounder, especially on the east coast. FLA 1 species are mostly targeted with setnets in harbours. Interactions with other species are currently being characterised.

- **Total FLA in Hauraki Gulf**

Because the Hauraki Gulf sand flounder CPUE series was rejected by the Northern Inshore Working Group, a total FLA CPUE analysis is substituted, which will be predominantly comprised of mixed sand flounder and yellowbelly flounder.

Stock Status	
Year of Most Recent Assessment	2018
Assessment Runs Presented	Standardised CPUE for Hauraki Gulf
Reference Points	Target(s): Not established but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: Not established
Status in relation to Target	Unknown
Status in relation to Limits	Unknown
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status



CPUE and total annual estimated catches for FLA(TOT) in the Hauraki Gulf. Also shown is the fishing intensity (catch/CPUE), standardised relative to the geometric mean. Fishing year designated by second year of the pair.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The FLA(TOT) series shows an overall declining trend except for a three-year increase from 2002 to 2005 and a single strong increase in the final 2017 fishing year, which brings the series above the long-term average.
Recent Trend in Fishing Intensity or Proxy	Fishing intensity appears to be dropping after peaking in 2005
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unknown
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

Assessment Methodology		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2018	Next assessment: 2021
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	Catch and effort data	1 – High Quality
Data not used (rank)	-	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- Uncertainty in the catch of sand flounder	

Qualifying Comments
The lack of species specific reporting for FLA stocks limits the ability to assess these stocks.

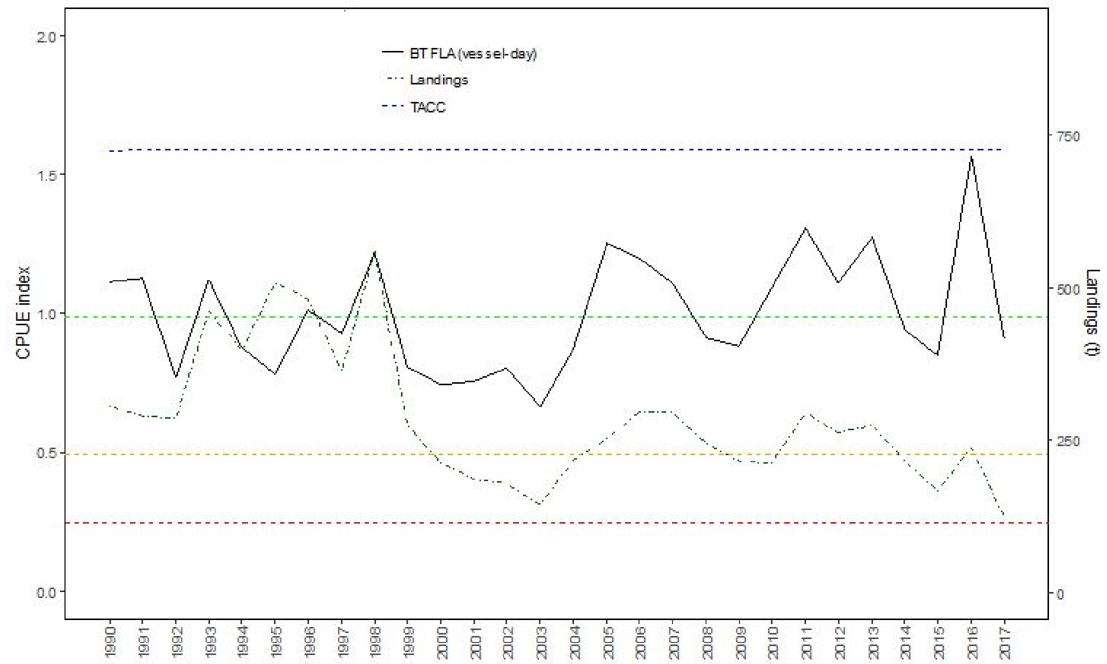
Fishery Interactions
Main QMS bycatch species is yellowbelly flounder, especially on the east coast. FLA 1 species are mostly targeted with setnets in harbours. Interactions with other species are under characterisation.

- **FLA 2**

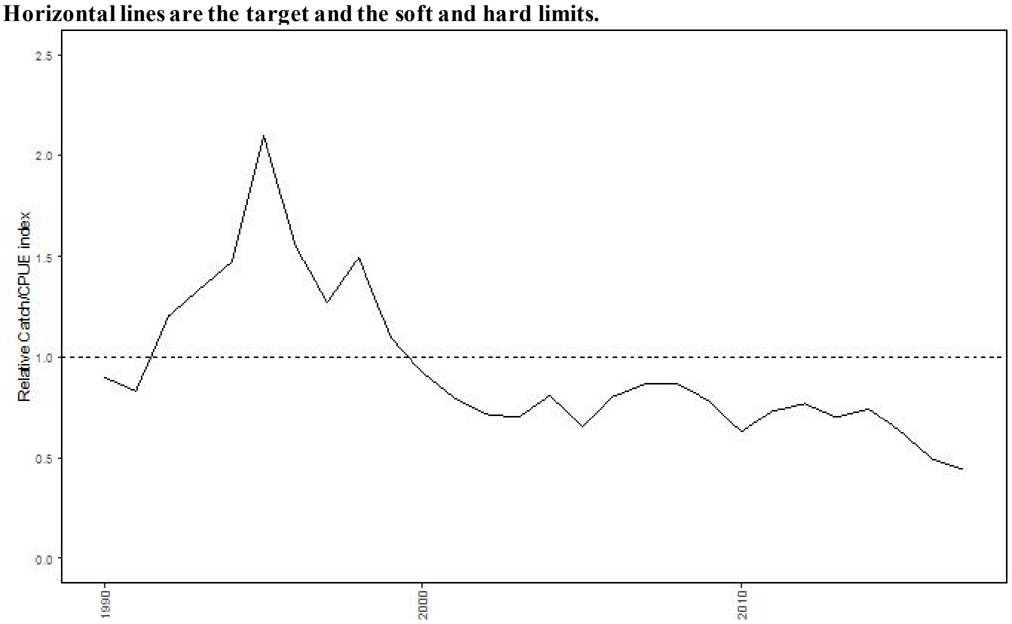
Stock Structure Assumptions
Sand flounder off the East Coast (FMA2) of North Island appear to be a single continuous population. The stock structure of New Zealand sole (ESO) is unknown.

Stock Status	
Year of Most Recent Assessment	2018
Assessment Runs Presented	Standardised CPUE for all flatfish combined in FLA 2
Reference Points	Target: B_{MSY}-compatible proxy based on the mean CPUE 1989–90 to 2012–13 for the bottom trawl flatfish target series Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: F_{MSY}
Status in relation to Target	About as Likely as Not (40–60%) to be at or above the target
Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	Overfishing is Very Unlikely (< 10%) to be occurring

Historical Stock Status Trajectory and Current Status



Annual landings and standardised CPUE index based on positive catches for BT_FLA, (all flatfish species combined) at day resolution (Schofield et al 2018b). Fishing years are labelled according to the second calendar year e.g. 1990 = 1989–90. Horizontal lines are the target and the soft and hard limits.



Annual relative exploitation rate for flatfish in FLA 2.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Relative abundance has fluctuated without trend since 1989–90 and is currently just below the target.
Recent Trend in Fishing Intensity or Proxy	Fishing intensity has trended down since the mid-1990s and is currently below the reference period (1990–2013) average
Other Abundance Indices	Tow based CPUE analysis for SFL and ESO from 2007–08 to 2016–17 data are reasonably consistent with the aggregated data index for combined species, although the decrease in abundance from 2016 to 2017 is more evident in ESO than SFL
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Stock is likely to continue to fluctuate around current levels
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown for TACC; Unlikely (< 40%) for current catch Hard Limit: Unknown for TACC; Unlikely (< 40%) for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown for TACC; Unlikely (< 40%) for current catch

Assessment Methodology		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2018	Next assessment: 2019
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-	

Qualifying Comments
-

Fishery Interactions
The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main fisheries landing flatfish as bycatch in FLA 2 target gurnard, snapper and trevally. Interactions with other species are currently being characterised.

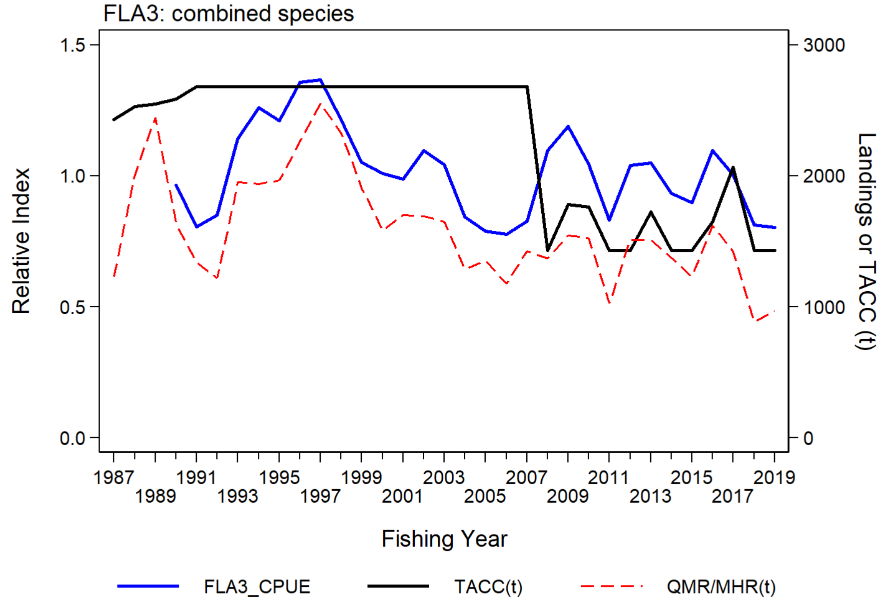
- **FLA 3 (all species combined)**

Stock Structure Assumptions

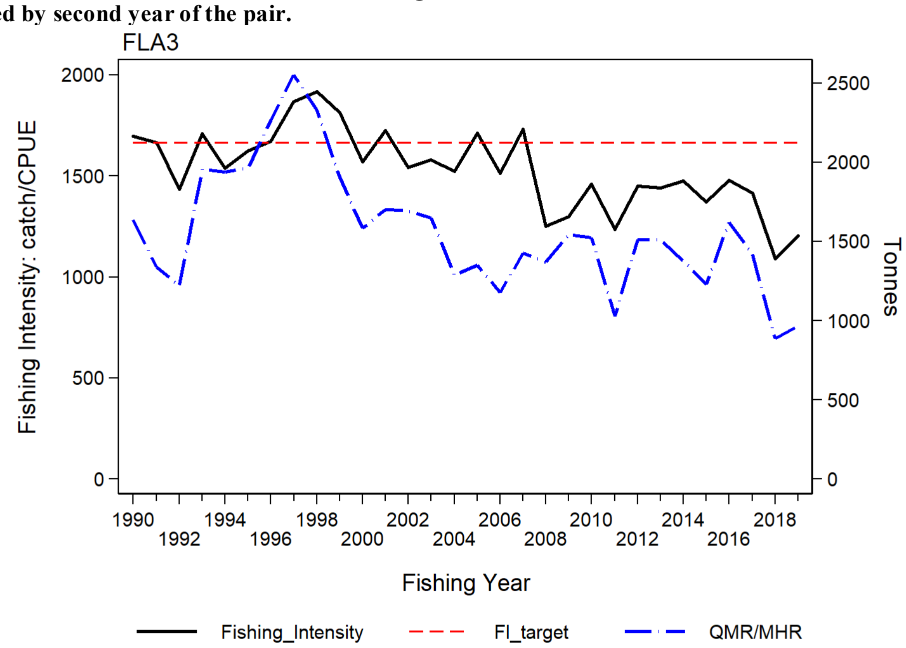
New Zealand sole and lemon sole appear to be a continuous population extending from Canterbury Bight to Foveaux Strait. Sand flounder off the East and South Coasts of South Island show localised concentrations that roughly correspond to the existing statistical areas. The stock relationships among these localised concentrations are unknown.

Stock Status	
Year of Most Recent Assessment	2020
Assessment Runs Presented	Standardised lognormal bottom trawl CPUE for all flatfish combined in FLA 3
Reference Points	Target: F_{MSY} proxy Soft Limit: to be determined Hard Limit: to be determined Overfishing threshold: F_{MSY} proxy
Status in relation to Target	Fishing mortality is Likely (> 60%) to be at or below the target
Status in relation to Limits	Soft limit: Not determined Hard Limit: Not determined
Status in relation to Overfishing	Unlikely (< 40%) that overfishing is occurring

Historical Stock Status Trajectory and Current Status



Standardised CPUE indices based on positive catches for all flatfish species combined (Starr & Kendrick 2020a). Also shown are the QMR/MHR declared FLA 3 landings and the annual FLA 3 commercial catch allowance. Fishing year designated by second year of the pair.



Fishing intensity (catch/CPUE) and a target fishing intensity calculated by dividing the base FLA 3 TACC by the CPUE associated with the base FLA 3 TACC from the catch/CPUE regression (left panel, Figure 8). Also plotted are the annual FLA 3 QMR/MHR landings. Fishing year designated by second year of the pair.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE has fluctuated over the long-term near the 30-year mean.
Recent Trend in Fishing Intensity or Proxy	Fishing intensity has dropped since the reduction of the TACC in 2007–08 and the introduction of in-season variation to commercial catch allowance and remains below the F_{MSY} proxy.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Stockexpected to vary in abundance around the long-term mean
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unknown
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unlikely (<40%) to cause overfishing

Assessment Methodology		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2020	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- Mixed species complex managed without explicitly considering each species - Uncertainty in stock structure assumptions	

Qualifying Comments
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Fishery Interactions
The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main target species landing flatfish as bycatch in FLA 3 are red cod, barracouta, stargazer, gurnard, tarakihi and elephant fish. Interactions with other species are currently being characterised.

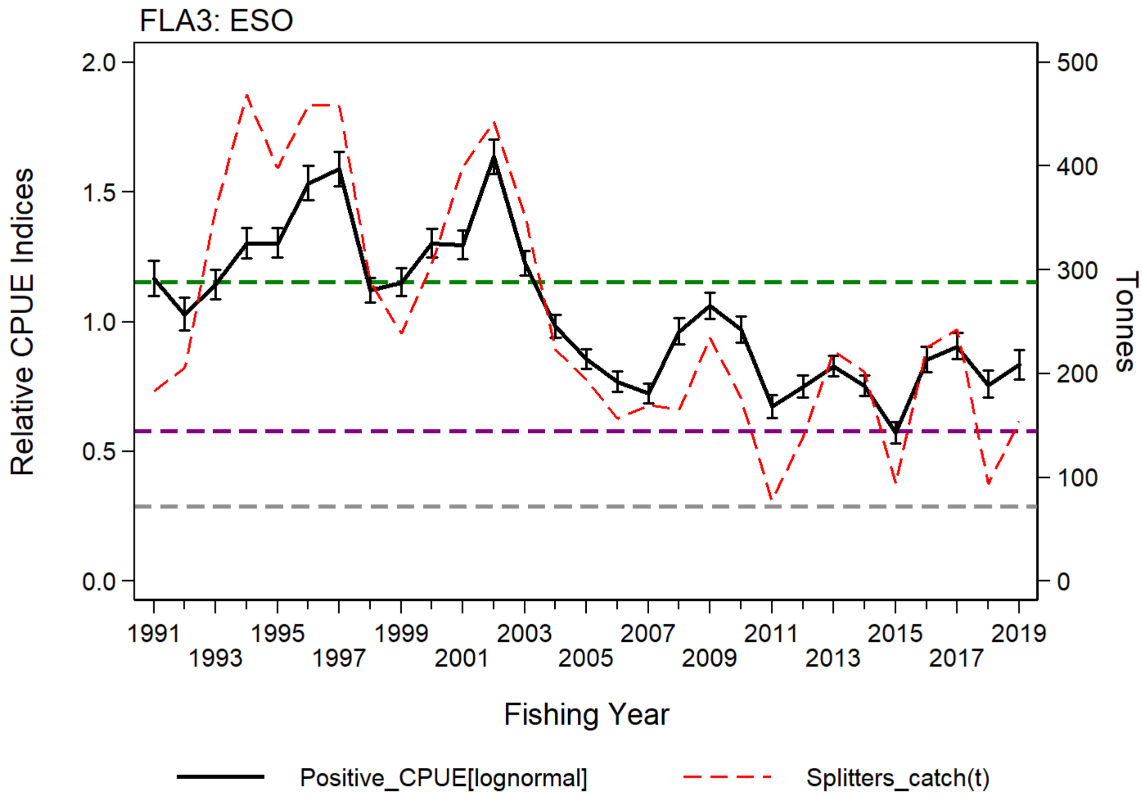
- **FLA 3: New Zealand (ESO) sole**

Stock Structure Assumptions

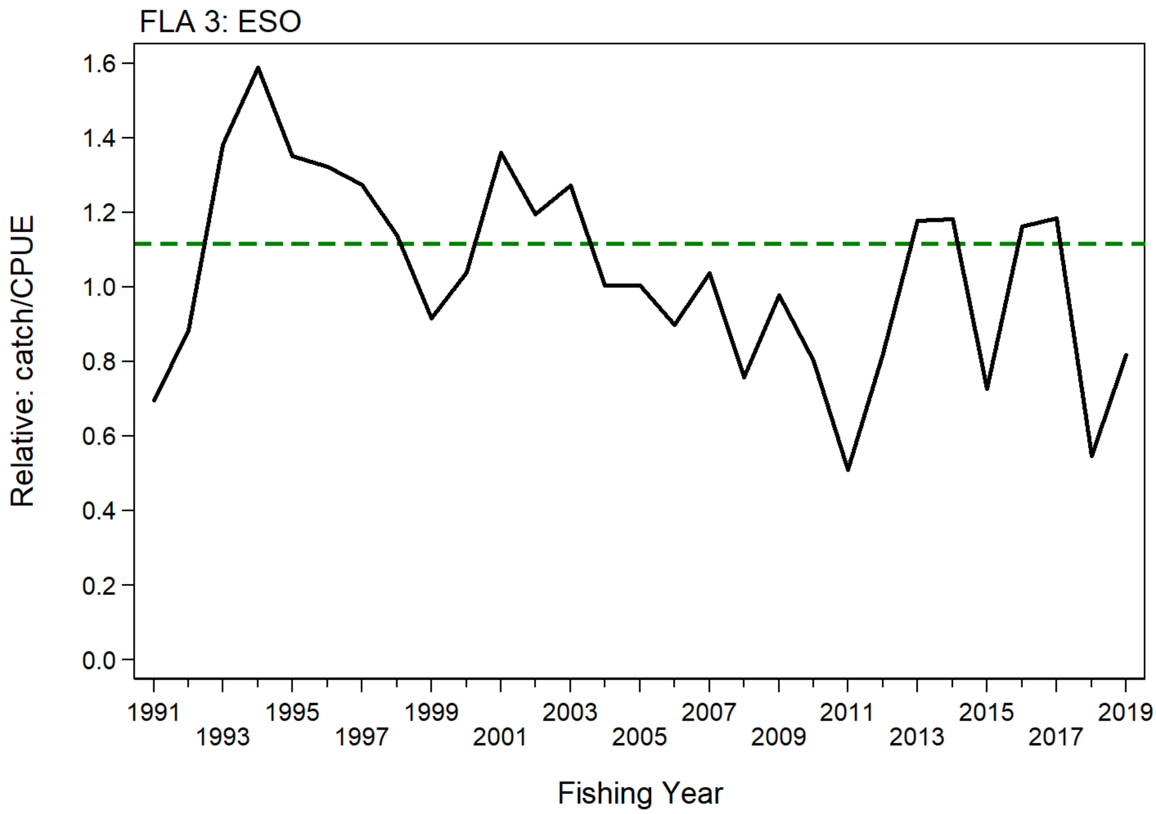
New Zealand sole appear to be a continuous population extending from Canterbury Bight to Foveaux Strait.

Stock Status	
Year of Most Recent Assessment	2020
Assessment Runs Presented	Standardised lognormal bottom trawl CPUE for ESO in FLA 3, based on trips which landed FLA 3 but which did not use the FLA species code
Reference Points	Interim Target: B_{MSY} proxy based on mean standardised CPUE from 1990–91 to 2006–07 (the final year of unconstrained catches) Soft Limit: 50% B_{MSY} proxy Hard Limit: 25% B_{MSY} proxy Overfishing threshold: F_{MSY} proxy based on mean relative exploitation rate for the period 1990–91 to 2006–07
Status in relation to Target	Unlikely (< 40%) to be at or above target
Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	Unlikely (< 40%) that overfishing is occurring

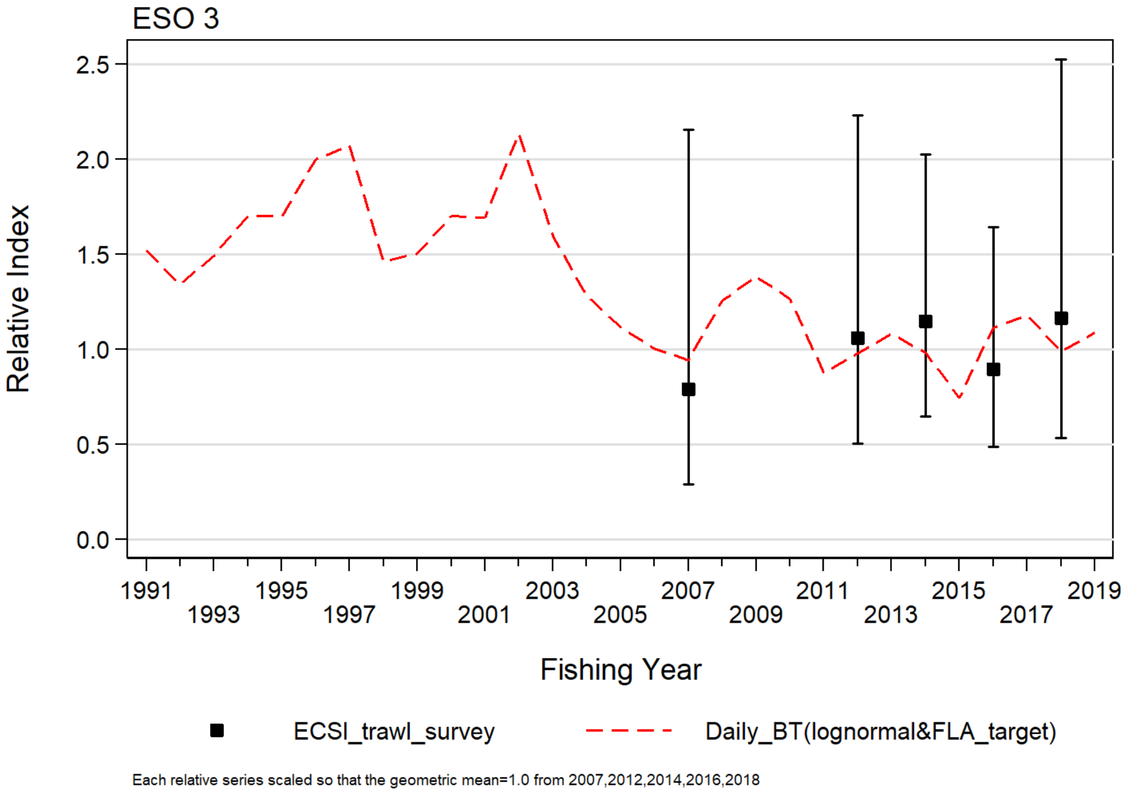
Historical Stock Status Trajectory and Current Status



Standardised CPUE indices based on lognormal CPUE series for New Zealand sole (ESO), showing the agreed *BMSY* proxy (green dashed line: average 1990–91 to 2006–07 CPUE index) and the associated Soft (purple dashed line) and Hard (grey dashed line) Limits (Starr & Kendrick 2020a). Also shown is the ESO estimated catch by trips that landed FLA 3 but which did not use the FLA code. Fishing year designated by second year of the pair.



Relative fishing intensity for ESO in FLA 3, based on the ESO 'splitter' catch and the standardised lognormal ESO CPUE series. The horizontal dashed green line corresponds to the mean fishing intensity for the period 1991–2007.



Standardised indices based on the lognormal CPUE series for New Zealand sole (ESO), shown with the 5 total (core+shallow strata) trawl survey ESO biomass indices from the *Kaharoa* ECSI winter trawl survey.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE has declined from a peak reached in 2001–02 but has remained above the Soft Limit since 2007–08.
Recent Trend in Fishing Intensity or Proxy	Fishing intensity has declined to below the target in the most recent two years
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Unlikely (< 40%) to be at or above target
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unlikely (<40%) for current catch Hard Limit: Very Unlikely (< 10%) for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	As Likely as Not (40-60%) for current catch

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2020	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- uncertainty in stock structure assumptions	

Qualifying Comments
The lack of historic species specific reporting for FLA stocks limits the ability to assess the long-term trends in these stocks; there is an expectation that the adoption of Eletronic Reporting of catch will improve the reporting of species-specific estimated flatfish catch.

Fishery Interactions
The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main target species landing flatfish as bycatch in FLA 3 are red cod, barracouta, stargazer, gurnard, tarakihi and elephant fish.

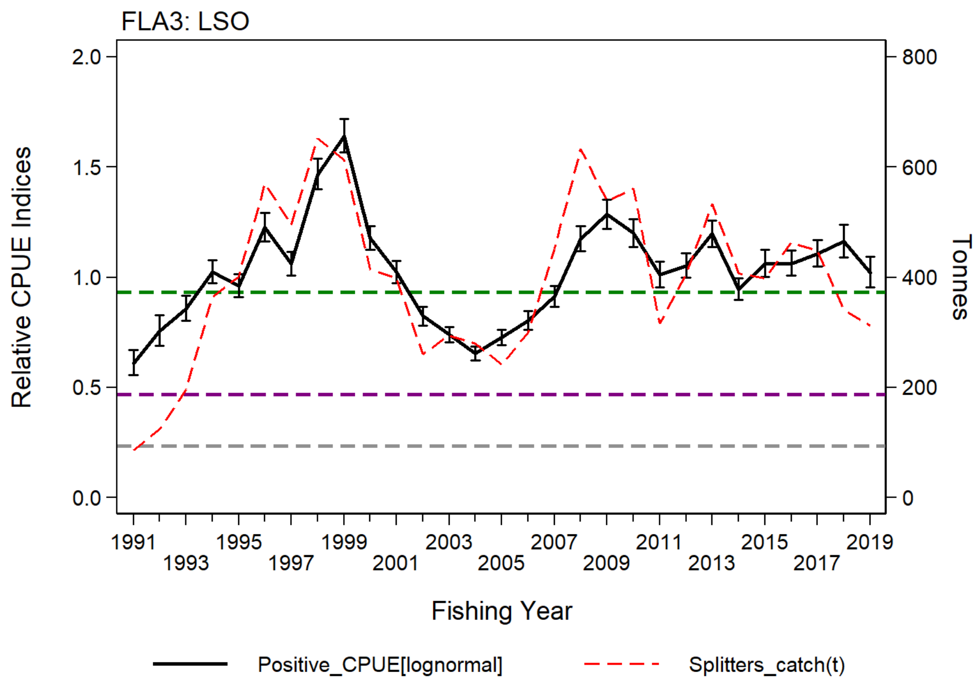
- **FLA 3: Lemon (LSO) sole**

Stock Structure Assumptions

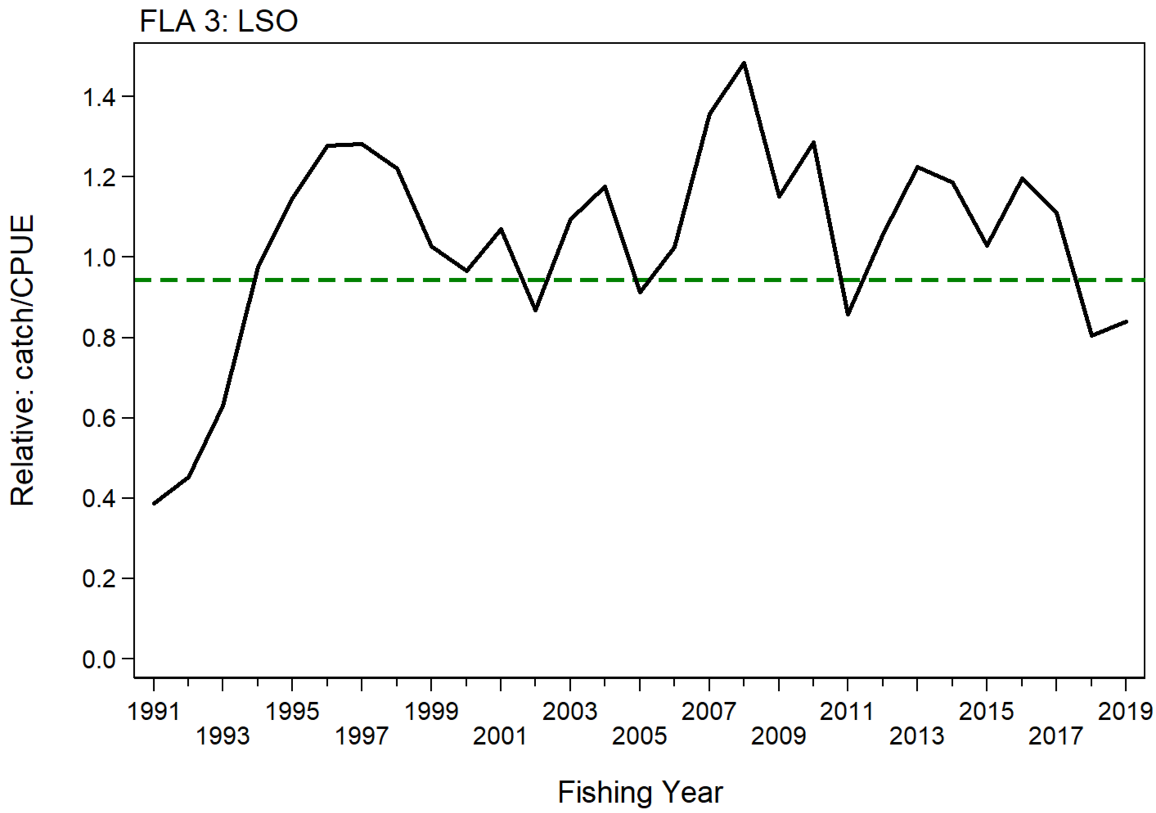
Lemon sole appear to be a continuous population extending from Canterbury Bight to Foveaux Strait.

Stock Status	
Year of Most Recent Assessment	2020
Assessment Runs Presented	Standardised lognormal bottom trawl CPUE for LSO in FLA 3, based on trips which landed FLA 3 but which did not use the FLA species code
Reference Points	Interim Target: B_{MSY} proxy based on mean standardised CPUE from 1990–91 to 2006–07 (the final year of unconstrained catches) Soft Limit: 50% B_{MSY} proxy Hard Limit: 25% B_{MSY} proxy Overfishing threshold: F_{MSY} proxy based on mean relative exploitation rate for the period 1990–91 to 2006–07
Status in relation to Target	About as Likely as Not (40–60%) to be at or above target
Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	About as Likely as Not (40–60%) that overfishing is occurring

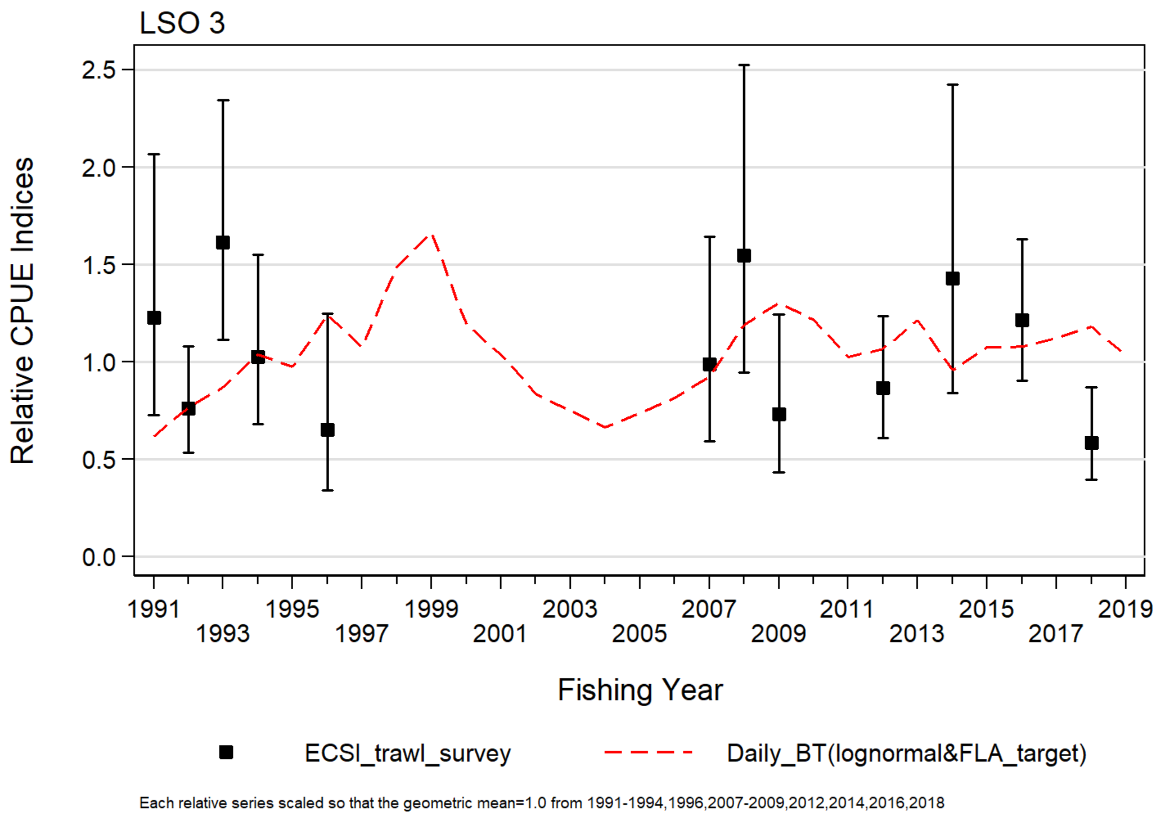
Historical Stock Status Trajectory and Current Status



Standardised indices based on lognormal CPUE series for Lemon sole (LSO), showing the agreed B_{MSY} proxy (green dashed line: average 1990–91 to 2006–07 CPUE index) and the associated Soft (purple dashed line) and Hard (grey dashed line) Limits (Starr & Kendrick 2020a). Also shown is the LSO estimated catch by trips that landed FLA 3 but which did not use the FLA code. Fishing year designated by second year of the pair.



Relative fishing intensity for LSO in FLA 3, based on the LSO 'splitter' catch and the standardised lognormal LSO CPUE series. The horizontal dashed green line corresponds to the mean fishing intensity for the period 1991–2007.



Standardised indices based on the lognormal CPUE series for Lemon sole (LSO) shown with the 12 trawl survey LSO core strata biomass indices from the *Kaharoa* ECSI winter trawl survey. Fishing year designated by second year of the pair.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE reached a nadir in 2003–04, but then climbed to a new level near the long-term mean in 2007–08 and has since remained at that level.
Recent Trend in Fishing Intensity or Proxy	Fishing intensity has fluctuated, mostly above the F_{MSY} proxy since 1994–95 but has dropped to just below target in 2017-18 and 2018–19
Other Abundance Indices	Relative abundance from the ECSI winter trawl survey has fluctuated without trend since 1991.
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	About as Likely or Not (40-60%) to remain at or above the target
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Very Unlikely (< 10%) Hard Limit: Very Unlikely (< 10%)
Probability of Current Catch or TACC causing Overfishing to continue or to commence	For current catch, About as Likely as Not (40–60%) to occur

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2020	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- uncertainty in stock structure assumptions	
Qualifying Comments		
The lack of historic species specific reporting for FLA stocks limits the ability to assess the long-term trends in these stocks; there is an expectation that the adoption of Eletronic Reporting of catch will improve the reporting of species-specific estimated flatfish catch.		

Fishery Interactions
The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main target species landing flatfish as bycatch in FLA 3 are red cod, barracouta, stargazer, gurnard, tarakihi and elephant fish. Interactions with protected species are believed to be low. Incidental captures of seabirds occur.

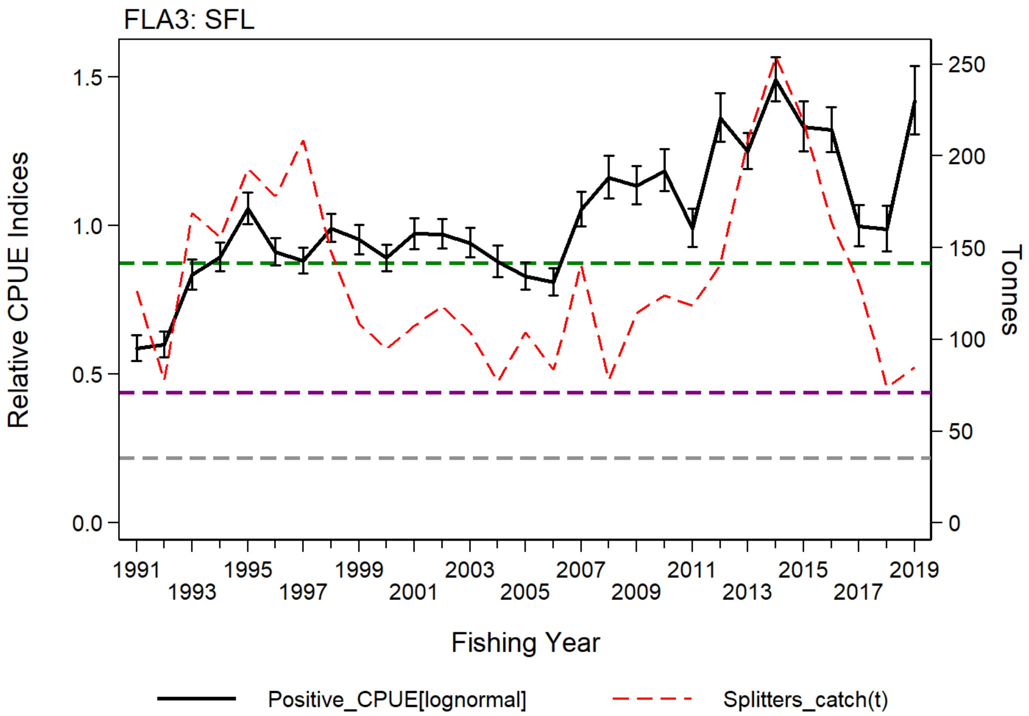
- **FLA 3: Sand Flounder (SFL)**

Stock Structure Assumptions
Sand flounder off the East and South Coasts of South Island show localised concentrations that roughly correspond to the existing statistical areas. The stock relationships among these localised concentrations are unknown.

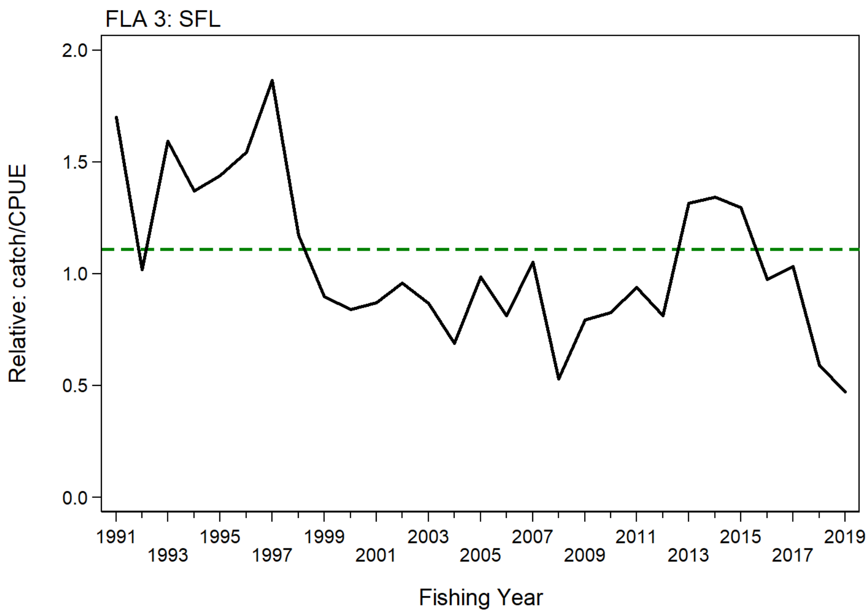
Stock Status	
Year of Most Recent Assessment	2020
Assessment Runs Presented	Standardised lognormal bottom trawl CPUE for SFL in FLA 3, based on trips which landed FLA 3 but which did not use the FLA species code
Reference Points	Interim Target: B_{MSY} proxy based on mean standardised CPUE

	from 1990–91 to 2006–07 (the final year of unconstrained catches) Soft Limit: 50% B_{MSY} proxy Hard Limit: 25% B_{MSY} proxy Overfishing threshold: F_{MSY} proxy based on mean relative exploitation rate for the period 1990–91 to 2006–07
Status in relation to Target	Very Likely (> 90%) to be at or above target
Status in relation to Limits	Soft Limit: Very Unlikely (< 10%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	Unlikely (< 40%) that overfishing is occurring

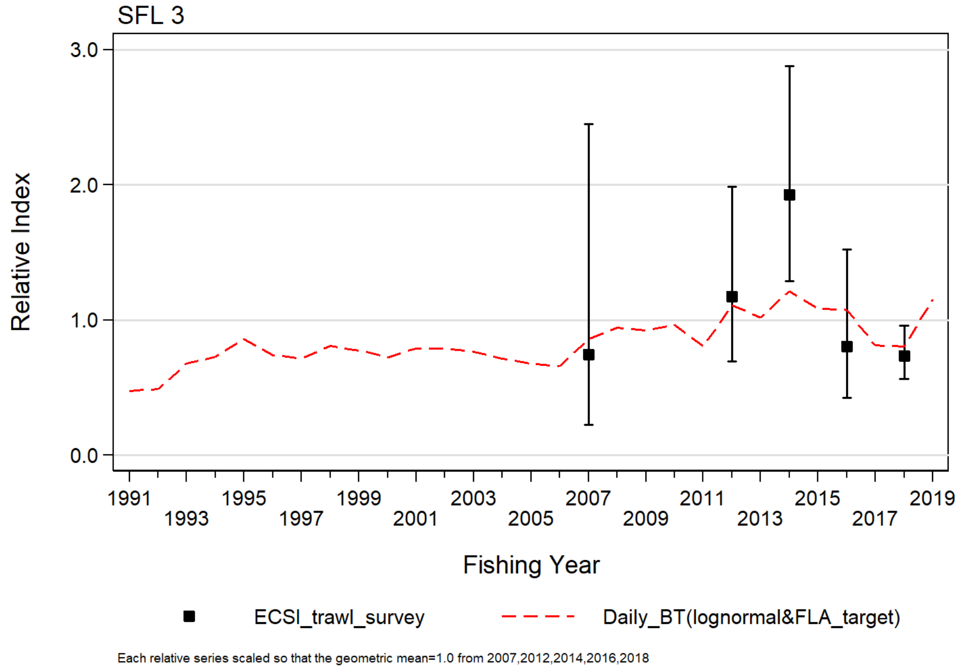
Historical Stock Status Trajectory and Current Status



Standardised indices based on lognormal CPUE series for Sand flounder (SFL), showing the agreed *B_{MSY}* proxy (green dashed line: average 1990–91 to 2006–07 CPUE index) and the associated Soft (purple dashed line) and Hard (grey dashed line) Limits (Starr & Kendrick 2018). Also shown is the SFL estimated catch by trips that landed FLA 3 but which did not use the FLA code. Fishing year designated by second year of the pair.



Relative fishing intensity for SFL in FLA 3, based on the SFL 'splitter' catch and the standardised lognormal SFL CPUE series. The horizontal dashed green line corresponds to the mean fishing intensity for the period 1991–2007.



Standardised indices based on the lognormal CPUE series for sand flounder (SFL), shown with the 5 total (core+shallow strata) trawl survey SFL biomass indices from the *Kaharoa* ECSI winter trawl survey.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE rose from a nadir in 2003–04 to above the long-term mean by 2007–08 and has fluctuated above this level since then.
Recent Trend in Fishing Intensity or Proxy	Fishing intensity has dropped steeply since 2014–15 and was well below the target in 2018–19
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	- Likely (> 60%) to remain at or above the target
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Very Unlikely (< 10%) for current catch Hard Limit: Very Unlikely (< 10%) for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unlikely (< 40%) for current catch

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2020	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- uncertainty in stock structure assumptions	

Qualifying Comments
The lack of historic species specific reporting for FLA stocks limits the ability to assess the long-term trends in these stocks; there is an expectation that the adoption of Eletronic Reporting of catch will improve the reporting of species-specific estimated flatfish catch.

Fishery Interactions
The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main target species landing flatfish as bycatch in FLA 3 are red cod, barracouta, stargazer, gurnard, tarakihi and elephant fish. Interactions with other species are currently being characterised.

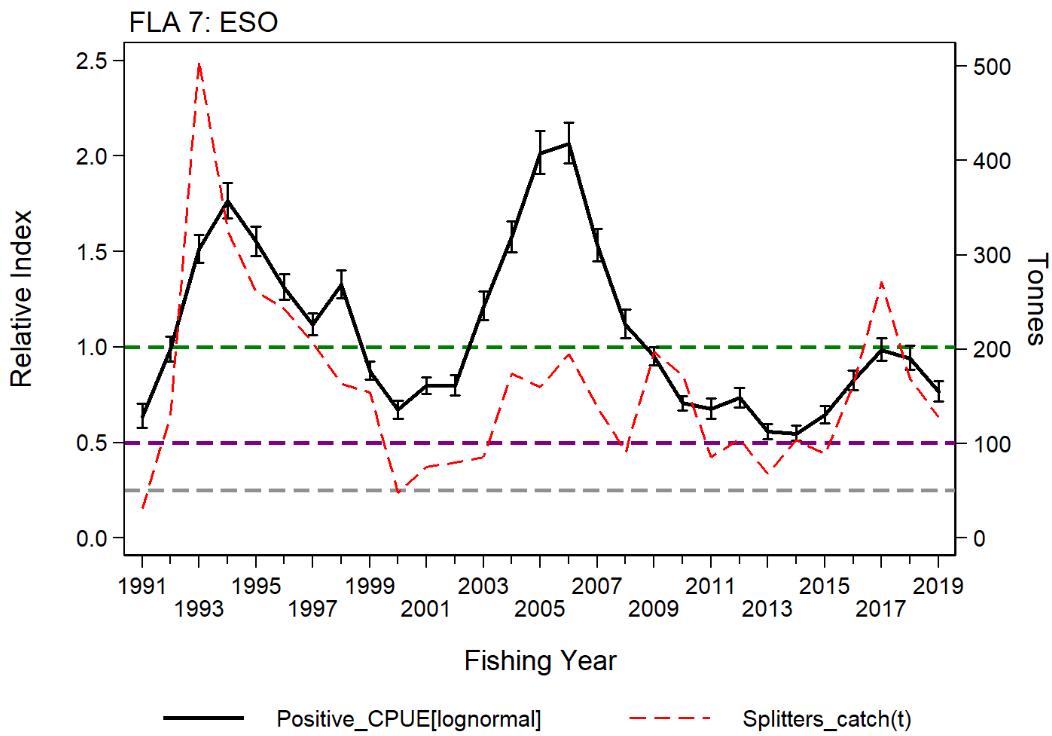
- **FLA 7: New Zealand (ESO) sole**

Stock Structure Assumptions

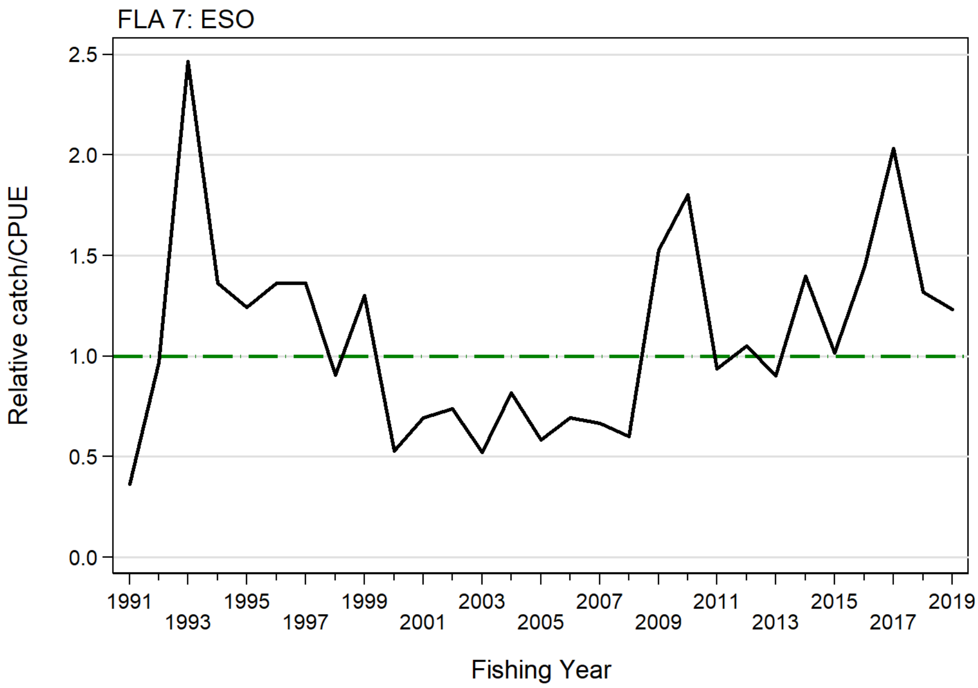
New Zealand sole are mostly taken off the west coast South Island portion of FLA 7, and there is very little catch taken in Tasman/Golden Bay. The CPUE analysis presented in the table below is based on catch and effort data from the west coast (Areas 032, 033, 034 and 035).

Stock Status	
Year of Most Recent Assessment	2020
Assessment Runs Presented	Standardised lognormal bottom trawl CPUE for ESO in FLA 7, based on trips which landed FLA 7 but which did not use the FLA species code
Reference Points	Interim Target: B_{MSY} proxy based on mean standardised CPUE from 1990–91 to 2018–19 Soft Limit: 50% B_{MSY} proxy Hard Limit: 25% B_{MSY} proxy Overfishing threshold: F_{MSY} proxy based on mean relative exploitation rate for the period 1990–91 to 2018–19
Status in relation to Target	Unlikely (< 40%) to be at or above target
Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Very Likely (< 10%) to be below
Status in relation to Overfishing	Likely (> 60%) that overfishing is occurring

Historical Stock Status Trajectory and Current Status



Standardised indices based on lognormal CPUE series for New Zealand sole (ESO), showing the agreed *BMSY* proxy (green dashed line: average 1990–91 to 2018–19 CPUE index) and the associated Soft (purple dashed line) and Hard (grey dashed line) Limits (Starr & Kendrick 2020b). Also shown is the ESO estimated catch by trips that landed FLA 7 but which did not use the FLA code. Fishing year designated by second year of the pair.



Relative fishing intensity for ESO in FLA 7, based on the ESO 'splitter' catch and the standardised lognormal ESO CPUE series. The horizontal dashed green line corresponds to the mean fishing intensity for the period 1991–2019.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE declined from a 2005–06 peak to a low in 2013–14, increased to 2016–17 and declined again to 0.77 in 2018–19
Recent Trend in Fishing Intensity or Proxy	Fishing intensity has increased since 2010–11 to above the mean level.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Likely (> 60%) to remain below target for current catch
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unlikely (< 40%) for current catch Hard Limit: Very Unlikely (< 10%) for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Likely (> 60%) for current catch

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2020	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- uncertainty in stock structure assumptions	

Qualifying Comments
The lack of historic species specific reporting for FLA stocks limits the ability to assess the long-term trends in these stocks; there is an expectation that the adoption of Eletronic Reporting of catch will improve the reporting of species-specific estimated flatfish catch.

Fishery Interactions
The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main non-FLA target species landing flatfish as bycatch in FLA 7 are red cod, barracouta, gurnard and tarakihi. The bycatch of FLA 7 in other QMS species has averaged 18% of the total 1989–90 to 2018–19 FLA 7 catch.

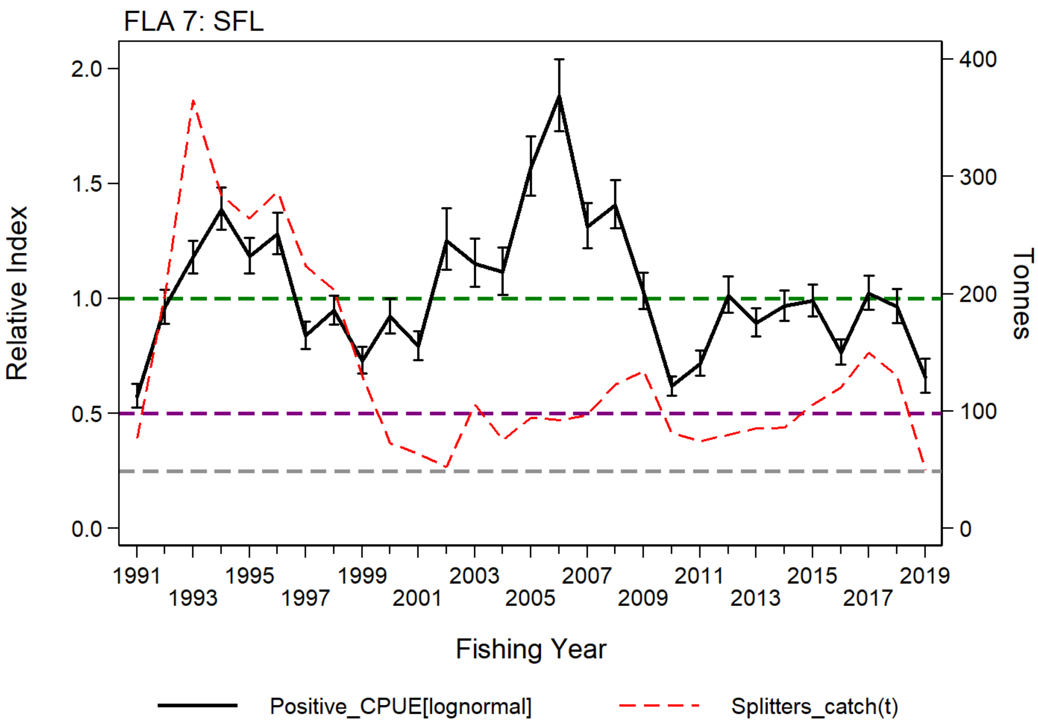
- **FLA 7: Sand Flounder (SFL)**

Stock Structure Assumptions

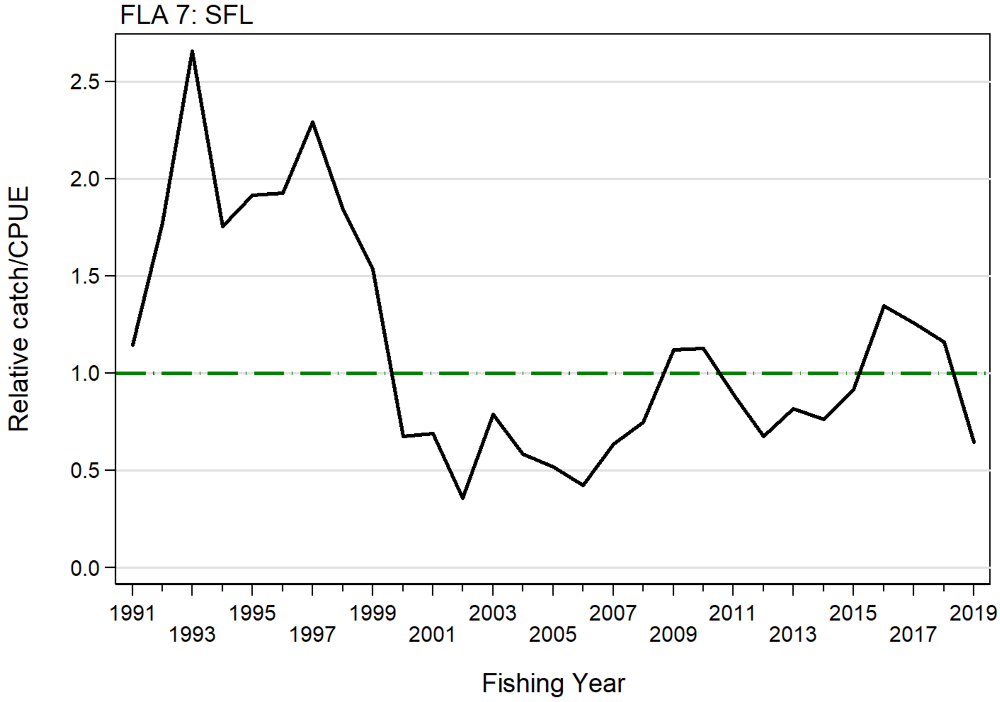
Sand flounder in FLA 7 is mostly taken in Tasman/Golden Bay, with a small component of the catch coming from eastern Cook Strait. There is very little SFL catch from the west coast of the South Island. The analysis presented in the table below is based on catch and effort data from Tasman/Golden Bays (Area 038).

Stock Status	
Year of Most Recent Assessment	2020
Assessment Runs Presented	Standardised lognormal bottom trawl CPUE for SFL in FLA 7, based on trips which landed FLA 7 but which did not use the FLA species code
Reference Points	Interim Target: B_{MSY} proxy based on mean standardised CPUE from 1990–91 to 2018–19 Soft Limit: 50% B_{MSY} proxy Hard Limit: 25% B_{MSY} proxy Overfishing threshold: F_{MSY} proxy based on mean relative exploitation rate for the period 1990–91 to 2018–19
Status in relation to Target	About as Likely as Not (40–60%) to be at or above target
Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	About as Likely as Not (40–60%) that overfishing is occurring

Historical Stock Status Trajectory and Current Status



Standardised indices based on lognormal CPUE series for Sand flounder (SFL), showing the agreed B_{MSY} proxy (green dashed line: average 1990–91 to 2018–19 CPUE index) and the associated Soft (purple dashed line) and Hard (grey dashed line) Limits (Starr & Kendrick 2020b). Also shown is the SFL estimated catch by trips that landed FLA 7 but which did not use the FLA code. Fishing year designated by second year of the pair.



Relative fishing intensity for SFL in FLA 7, based on the SFL'splitter' catch and the standardised lognormal SFL CPUE series. The horizontal dashed green line corresponds to the mean fishing intensity for the period 1991–2019.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE has fluctuated without trend near the long-term average from 2010–11;
Recent Trend in Fishing Intensity or Proxy	Fishing intensity dropped to relatively low levels in the late 2000s, and has since climbed back to the level of the F_{MSY} proxy
Other Abundance Indices	Relative abundance from the WCSI trawl survey has fluctuated without trend since 1992.
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	About as Likely as Not (40–60%) to remain near target for current catch
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unlikely (< 40%) for current catch Hard Limit: Very Unlikely (< 10%) for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	About as Likely as Not (40–60%) to remain near overfishing threshold for current catch

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2020	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- uncertainty in stock structure assumptions	

Qualifying Comments
The lack of historic species specific reporting for FLA stocks limits the ability to assess the long-term trends in these stocks; there is an expectation that the adoption of Eletronic Reporting of catch will improve the reporting of species-specific estimated flatfish catch.

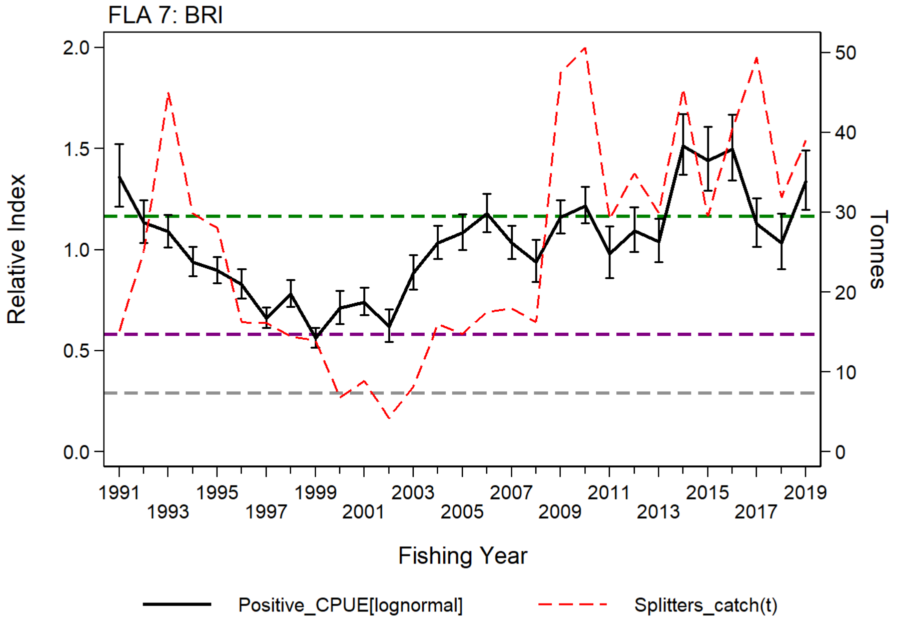
Fishery Interactions
The fishery is mainly confined to the inshore domestic trawl fleet fishing in Tasman/Golden Bays, which primarily targets gurnard and snapper, in addition to flatfish. Other species are incidental.

- **FLA 7: Brill (BRI)**

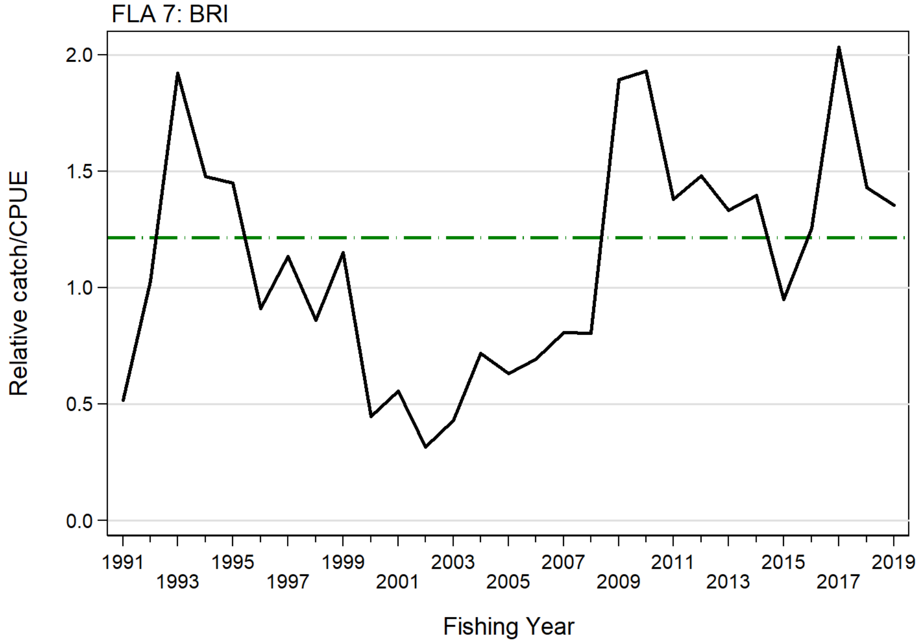
Stock Structure Assumptions
Brill are mostly taken off the west coast South Island portion of FLA 7, where they appear to comprise a continuous population, and there is very little catch taken in Tasman/Golden Bay. The CPUE analysis presented in the table below is based on catch and effort off the west coast (Areas 032, 033, 034 and 035).

Stock Status	
Year of Most Recent Assessment	2020
Assessment Runs Presented	Standardised lognormal bottom trawl CPUE for BRI in FLA 7, based on trips which landed FLA 7 but which did not use the FLA species code
Reference Points	Interim Target: B_{MSY} proxy based on mean standardised CPUE from 2004–05 to 2018–19 Soft Limit: 50% B_{MSY} proxy Hard Limit: 25% B_{MSY} proxy Overfishing threshold: F_{MSY} proxy based on mean relative exploitation rate for the period 1990–91 to 2018–19
Status in relation to Target	About as Likely as Not (40–60%) to be at or above target
Status in relation to Limits	Soft Limit: Very Unlikely (< 10%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	About as Likely as Not (40–60%) that overfishing is occurring

Historical Stock Status Trajectory and Current Status



Standardised indices based on lognormal CPUE series for Brill (BRI), showing the agreed B_{MSY} proxy (green dashed line: average 2004–05 to 2018–19 CPUE index) and the associated Soft (purple dashed line) and Hard (grey dashed line) Limits (Starr & Kendrick 2020b). Also shown is the BRI estimated catch by trips that landed FLA 7 but which did not use the FLA code. Fishing year designated by second year of the pair.



Relative fishing intensity for BRI in FLA 7, based on the BRI 'splitter' catch and the standardised lognormal BRI CPUE series. The horizontal dashed green line corresponds to the mean fishing intensity for the period 2005–2019.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE has been relatively constant at a high level since 2004–05 with a three-year excursion to 1.5X the long-term average from 2014–15 to 2016–17
Recent Trend in Fishing Intensity or Proxy	Fishing intensity has fluctuated, mostly above the F_{MSY} proxy since 2004–05, and was near the Fmsy proxy in 2018–19
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	About as Likely as Not (40–60%) to remain near target for current catch
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Very Unlikely (< 10%) for current catch Hard Limit: Very Unlikely (< 10%) for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	About as Likely as Not (40–60%) to remain near overfishing threshold for current catch

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2020	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- uncertainty in stock structure assumptions	

Qualifying Comments
The lack of historic species specific reporting for FLA stocks limits the ability to assess the long-term trends in these stocks; there is an expectation that the adoption of Eletronic Reporting of catch will improve the reporting of species-specific estimated flatfish catch.

Fishery Interactions
The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main non-FLA target species landing flatfish as bycatch in FLA 7 are red cod, barracouta, gurnard and tarakihi. The bycatch of FLA 7 in other QMS species has averaged 18% of the total 1989–90 to 2018–19 FLA 7 catch.

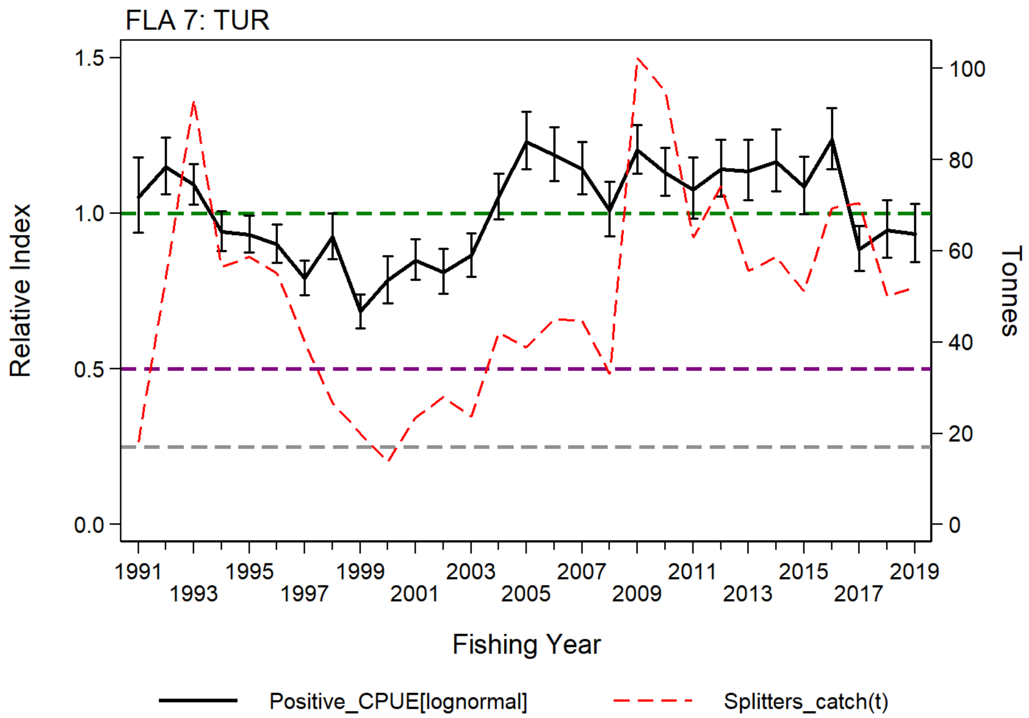
- **FLA 7: Turbot (TUR)**

Stock Structure Assumptions

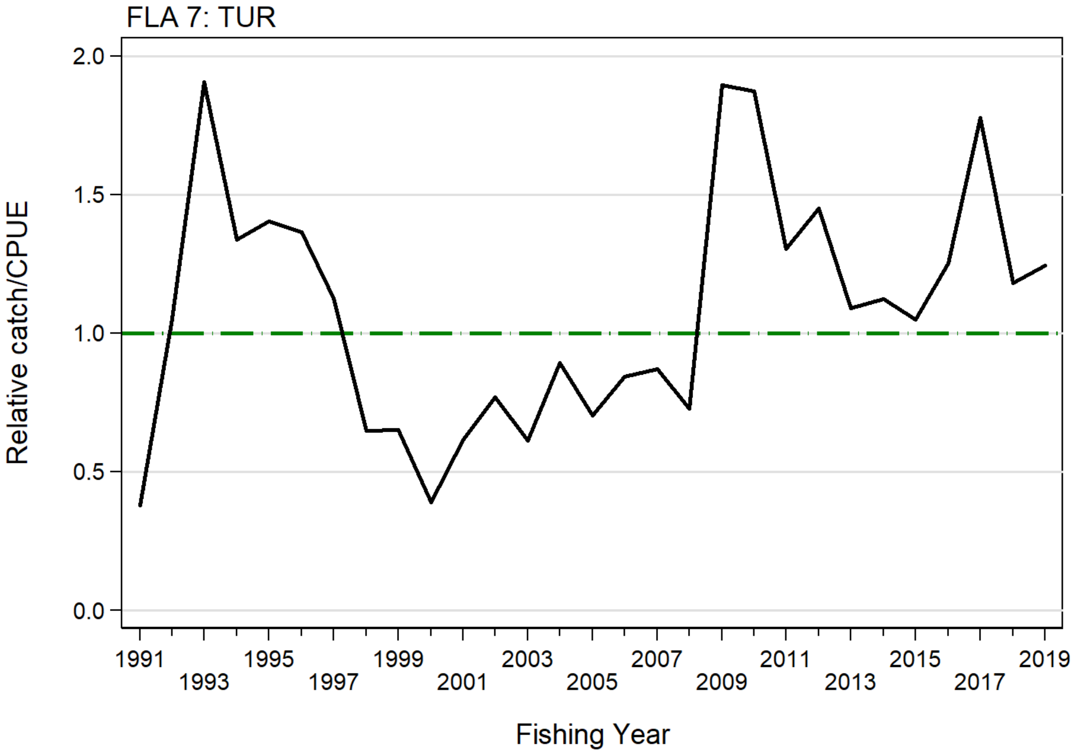
Turbot are mostly taken off the west coast South Island portion of FLA 7, where they appear to comprise a continuous population, and there is very little catch taken in Tasman/Golden Bay. The CPUE analysis presented in the table below is based on catch and effort off the west coast (Areas 032, 033, 034 and 035).

Stock Status	
Year of Most Recent Assessment	2020
Assessment Runs Presented	Standardised lognormal bottom trawl CPUE for TUR in FLA 7, based on trips which landed FLA 7 but which did not use the FLA species code
Reference Points	Interim Target: B_{MSY} proxy based on mean standardised CPUE from 1990–91 to 2018–19 Soft Limit: 50% B_{MSY} proxy Hard Limit: 25% B_{MSY} proxy Overfishing threshold: F_{MSY} proxy based on mean relative exploitation rate for the period 1990–91 to 2018–19
Status in relation to Target	About as Likely as Not (40–60%) to be at or above target
Status in relation to Limits	Soft Limit: Very Unlikely (< 10%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	About as Likely as Not (40–60%) that overfishing is occurring

Historical Stock Status Trajectory and Current Status



Standardised indices based on lognormal CPUE series for Turbot (TUR), showing the agreed B_{MSY} proxy (green dashed line: average 1990–91 to 2018–19 CPUE index) and the associated Soft (purple dashed line) and Hard (grey dashed line) Limits (Starr & Kendrick 2020b). Also shown is the TUR estimated catch by trips that landed FLA 7 but which did not use the FLA code. Fishing year designated by second year of the pair.



Relative fishing intensity for TUR in FLA 7, based on the TUR 'splitter' catch and the standardised lognormal TUR CPUE series. The horizontal dashed green line corresponds to the mean fishing intensity of-r the period 1991–2019.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE has been relatively stable in this fishery, with a long period above the long-term average from 2004–05 to 2015–16; CPUE has dropped to below the long-term average after 2016–17
Recent Trend in Fishing Intensity or Proxy	Fishing intensity has fluctuated, above the F_{MSY} proxy since 2007–08 and was just above the Fmsy proxy in 2018–19
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	About as Likely as Not (40–60%) to remain near target for current catch
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Very Unlikely (< 10%) for current catch Hard Limit: Very Unlikely (< 10%) for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	About as Likely as Not (40–60%) to remain near overfishing threshold for current catch

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE based on positive catches	
Assessment Dates	Latest assessment: 2020	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- uncertainty in stock structure assumptions	

Qualifying Comments
The lack of historic species specific reporting for FLA stocks limits the ability to assess the long-term trends in these stocks; there is an expectation that the adoption of Eletronic Reporting of catch will improve the reporting of species-specific estimated flatfish catch.

Fishery Interactions
The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main non-FLA target species landing flatfish as bycatch in FLA 7 are red cod, barracouta, gurnard and tarakihi. The bycatch of FLA 7 in other QMS species has averaged 18% of the total 1989–90 to 2018–19 FLA 7 catch.

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