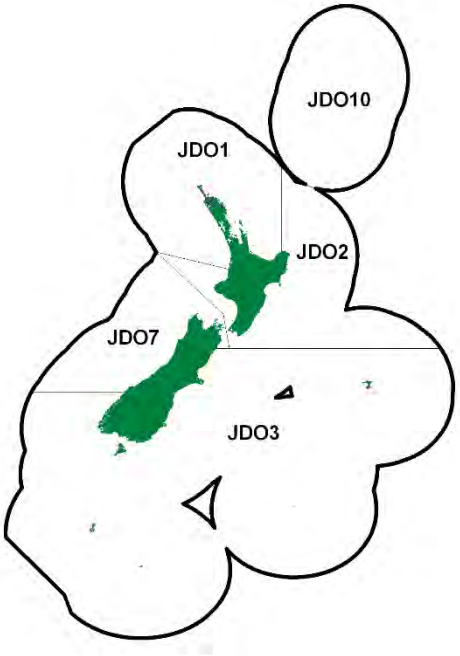
JOHN DORY (JDO)

(*Zeus faber*)
Kuparu



1. FISHERY SUMMARY

John dory was introduced into the QMS on 1 October 1986; current allowances, TACCs, and TACs are summarised in Table 1. The TACCs for JDO 1, JDO 2, and JDO 3 were increased gradually during the late 1980s and early 1990s. The TACC for JDO 7 was increased from 131 to 150 t in October 2012, and to 190 t on 1 October 2016. The TACC for JDO 10 has remained unchanged since 1986.

Table 1: TACs, TACCs, and allowances (t) for John dory.

Fishstock	Recreational allowance	Customary non-commercial allowance	Other mortality	TACC	TAC
JDO 1	–	–	–	354	354
JDO 2	–	–	–	270	270
JDO 3	–	–	–	32	32
JDO 7	4	2	11	230	247
JDO 10	–	–	–	10	10

1.1 Commercial fisheries

John dory are taken mainly as a bycatch of the trawl and Danish seine fisheries. In recent years, around 50–65% of the total reported catch has been taken in JDO 1 and around 20% taken in JDO 2. Reported landings for the main QMAs from 1931 to 1982 are given in Table 2. Recent reported landings by Fishstock are given in Table 3, and the historical landings and TACC values for the three main JDO stocks are depicted in Figure 1.

The increase in JDO 1 landings after 1986–87 is largely attributed to increased targeting of John dory by trawl and Danish seine. Annual catches reached a peak during 1994–95 to 1996–97, at about the level of the TACC of 704 t. There was a general decline in annual landings over the subsequent years. During 2009–10 to 2017–18, landings were maintained at about 350 t per annum, but in 2018–19 (when the TACC was lowered to 354 t) landings dropped below 300 t for the first time since 1975. Landings remained at this level in 2019–20, 2020–21, and 2021–22. Most of the decline in John dory catch occurred in the Hauraki Gulf-East Northland fishery. Annual catches from the west coast (FMA 9) have been maintained at about 80–140 t over the last 25 years (from 1990–91), predominantly as a bycatch of the snapper, red gurnard, and trevally trawl fisheries. Annual catches from the Bay of Plenty fishery (trawl and Danish seine) were about 80–120 t during the same period.

Annual landings in JDO 2 have never exceeded the TACC and, in the mid-90s, were around 50% of the TACC in each year (Figure 1). From 1999–00 to 2002–03 landings were above 200 t, but, in recent years landings have decreased, being below 150 t since 2009–10, with the lowest landings recorded in the last two years. Landings from JDO 2 are considered to be approximately equally split between FMAs 2 and 8. Substantial proportions of John dory landings are taken as bycatch in target trawl fisheries for jack mackerels in FMA 8, and as tarakihi and red gurnard bycatch in FMA 2.

Landings from JDO 7 increased markedly after 1999–2000, as a result of increasing abundance. JDO 7 catch is taken largely as a bycatch of FMA 7 trawl fisheries. The JDO 7 TACC has been increased six times since 2003–04 and is currently 230 t (Table 3). Landings in 2017–18 exceeded the TACC by 13 t but have remained below the increased TACCs since then.

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

Year	JDO 1	JDO 2	JDO 3	JDO 7	Year	JDO 1	JDO 2	JDO 3	JDO 7
1931–32	70	0	0	0	1957	110	37	0	20
1932–33	60	0	0	0	1958	132	54	0	40
1933–34	57	0	0	0	1959	157	64	0	50
1934–35	42	0	0	0	1960	158	81	0	53
1935–36	92	0	0	0	1961	156	76	0	52
1936–37	105	4	0	1	1962	150	87	0	38
1937–38	80	3	0	0	1963	114	96	0	44
1938–39	78	3	1	0	1964	112	85	1	30
1939–40	40	5	0	0	1965	111	101	0	32
1940–41	0	2	1	1	1966	148	110	0	37
1941–42	0	7	1	3	1967	162	102	0	41
1942–43	3	4	3	3	1968	203	83	0	36
1943–44	12	4	3	3	1969	189	96	0	19
1944	11	7	2	5	1970	259	137	0	24
1945	12	6	0	1	1971	234	141	1	38
1946	27	7	0	3	1972	213	122	0	34
1947	23	12	2	12	1973	259	99	0	30
1948	21	20	1	1	1974	340	101	0	28
1949	22	79	0	4	1975	261	92	0	22
1950	17	65	0	6	1976	362	135	0	55
1951	5	38	0	2	1977	315	141	0	73
1952	34	50	0	5	1978	392	119	0	24
1953	163	62	0	7	1979	503	121	0	29
1954	181	52	0	25	1980	563	173	0	26
1955	162	50	0	24	1981	646	186	0	38
1956	175	46	0	24	1982	577	162	0	28

Notes:

1. The 1931–1943 years are April–March but from 1944 onwards are calendar years.
2. Data up to 1985 are from fishing returns; data from 1986 to 1990 are from Quota Management Reports.
3. Data for the period 1931 to 1982 are based on reported landings by harbour and are likely to be underestimated as a result of under-reporting and discarding practices. Data includes both foreign and domestic landings. Data were aggregated to FMA using methods and assumptions described by Francis & Paul (2013).

Table 3: Reported landings (t) of John dory by Fishstock from 1983–84 to present and actual TACCs (t) for 1986–87 to present. QMS data from 1986–present. [Continued on next page]

Fishstock	JDO 1		JDO 2		JDO 3		JDO 7	
FMA (s)	1 & 9		2 & 8		3, 4, 5 & 6		7	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1983–84*	659	–	131	–	1	–	35	–
1984–85*	620	–	110	–	0	–	36	–
1985–86*	531	–	158	–	1	–	45	–
1986–87	409	510	168	240	3	30	57	70
1987–88	476	633	192	246	1	30	89	75
1988–89	480	662	151	253	6	30	47	82
1989–90	494	704	152	262	1	30	54	88
1990–91	505	704	171	269	1	31	53	88
1991–92	562	704	214	269	1	31	60	88
1992–93	578	704	217	269	8	31	50	91
1993–94	640	704	186	269	2	32	37	91
1994–95	721	704	140	270	3	32	30	91
1995–96	696	704	139	270	< 1	32	42	91
1996–97	689	704	140	270	< 1	32	35	91
1997–98	651	704	134	270	< 1	32	26	91
1998–99	672	704	182	270	< 1	32	34	91
1999–00	519	704	235	270	< 1	32	71	91
2000–01	497	704	217	270	1	32	104	91
2001–02	453	704	240	270	4	32	124	91

Table 3 [Continued]:

Fishstock	JDO 1		JDO 2		JDO 3		JDO 7	
FMA (s)	1 & 9		2 & 8		3, 4, 5 & 6		7	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
2002–03	440	704	239	270	2	32	114	91
2003–04	492	704	184	270	< 1	32	155	91
2004–05	561	704	182	270	1	32	133	114
2005–06	549	704	159	270	1	32	124	114
2006–07	544	704	143	270	1	32	127	114
2007–08	482	704	133	270	< 1	32	110	114
2008–09	411	704	136	270	< 1	32	116	114
2009–10	359	704	152	270	< 1	32	109	125
2010–11	386	704	138	270	< 1	32	112	125
2011–12	351	704	131	270	< 1	32	126	125
2012–13	365	704	138	270	< 1	32	128	150
2013–14	349	704	142	270	< 1	32	151	150
2014–15	354	704	147	270	< 1	32	150	150
2015–16	342	704	129	270	< 1	32	151	190
2016–17	361	704	139	270	1	32	177	190
2017–18	322	704	135	270	1	32	203	190
2018–19	279	354	135	270	1	32	197	209
2019–20	255	354	124	270	1	32	178	230
2020–21	287	354	101	270	2	32	189	230
2021–22	271	354	98	270	2	32	179	230
2022–23	235	354	90	270	1	32	158	230

Fishstock	JDO 10			
FMA (s)	10		Total	
	Landings	TACC	Landings	TACC
1983–84*	0	–	826	–
1984–85*	0	–	766	–
1985–86*	0	–	735	–
1986–87	< 1	10	638	860
1987–88	0	10	758	994
1988–89	0	10	684	1 037
1989–90	0	10	701	1 094
1990–91	0	10	730	1 102
1991–92	0	10	837	1 102
1992–93	0	10	853	1 105
1993–94	0	10	865	1 106
1994–95	0	10	894	1 107
1995–96	0	10	877	1 107
1996–97	0	10	864	1 107
1997–98	0	10	811	1 107
1998–99	0	10	889	1 107
1999–00	0	10	826	1 107
2000–01	0	10	819	1 107
2001–02	0	10	819	1 107
2002–03	0	10	795	1 107
2003–04	0	10	832	1 107
2004–05	0	10	877	1 129
2005–06	0	10	833	1 129
2006–07	0	10	815	1 129
2007–08	0	10	725	1 129
2008–09	0	10	663	1 129
2009–10	0	10	620	1 140
2010–11	0	10	637	1 140
2011–12	0	10	609	1 140
2012–13	0	10	633	1 165
2013–14	0	10	642	1 165
2014–15	0	10	652	1 165
2015–16	0	10	622	1 205
2016–17	0	10	678	1 205
2017–18	0	10	661	1 205
2018–19	0	10	612	874
2019–20	0	10	558	895
2020–21	0	10	579	895
2021–22	0	10	550	895
2022–23	0	10	484	895

* FSU data.

Overall, the majority of John dory catch is reported from the snapper bottom trawl fishery (16%), followed by the John dory bottom trawl (14%), and the tarakihi bottom trawl fisheries (14%). Danish seine accounts for the second largest John dory catch across fishing methods.

Catches of John dory in JDO 1 are predominantly taken by bottom trawl in the snapper (23%), John dory (19%), and trevally (10%) target fisheries. Danish seine, bottom pair trawl, and bottom longline comprise the remaining John dory catch by fishing method. John dory in JDO 2 are taken predominantly by bottom trawl targeting tarakihi (30%) and gurnard (25%), with midwater and set net fishing methods comprising the remainder of the catch. John dory in JDO 7 is predominantly caught by bottom trawl targeting flatfish (25%), barracouta (23%), and tarakihi (18%). Throughout the North Island, the trawl and Danish seine fisheries targeting John dory take the majority of their catch when targeting snapper (33%) followed by the John dory target fishery (23%). No data were available for JDO set net fisheries in the South Island.

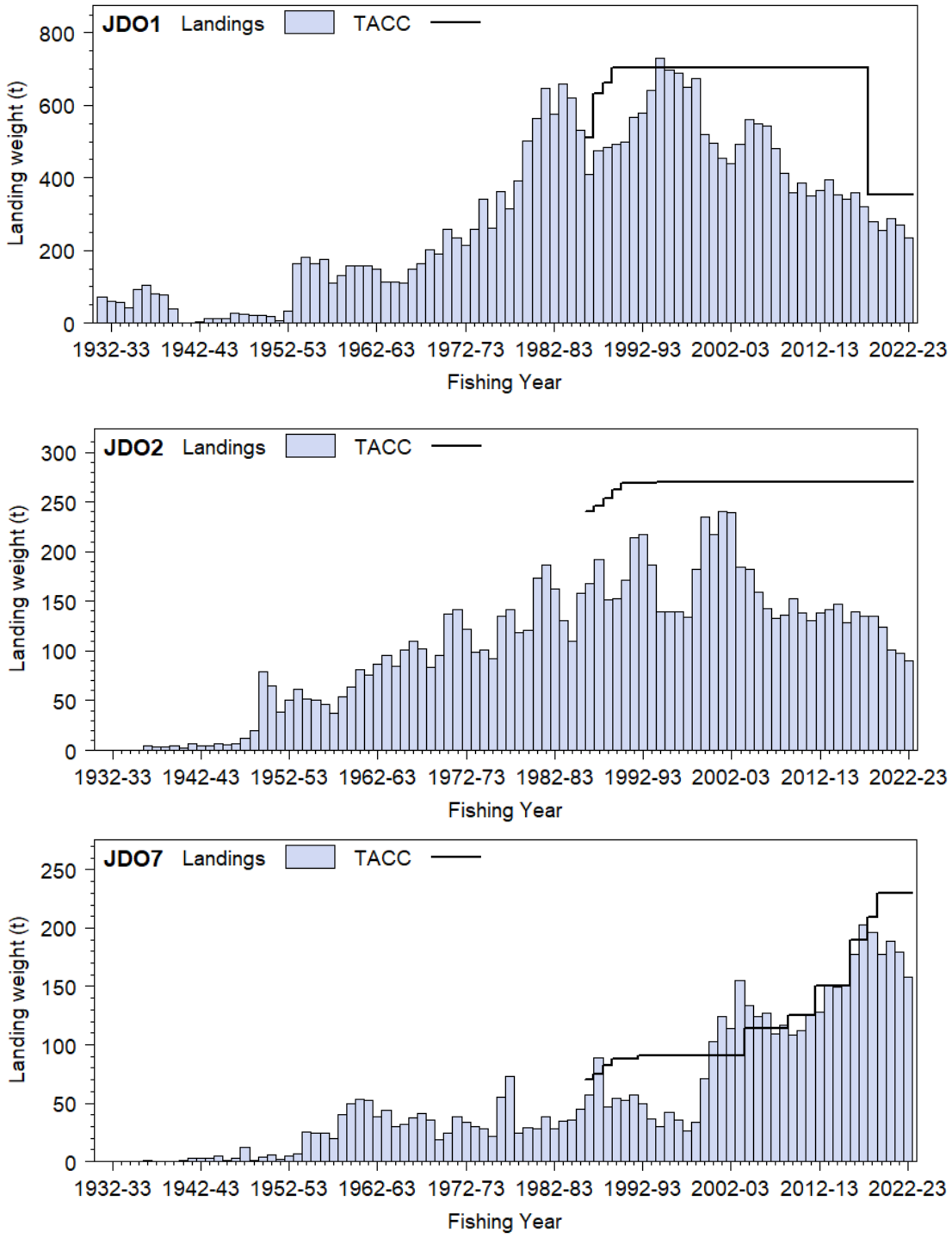


Figure 1: Reported commercial landings and TACC for the three main JDO stocks. JDO 1 (Auckland East), JDO 2 (Central East), and JDO 7 (Challenger).

1.2 Recreational fisheries

John dory is an important recreational species in the north of New Zealand. They are caught using line fishing methods, predominantly by rod and reel with some longline catch.

1.2.1 Management controls

The main method used to manage recreational harvests of John dory is daily bag limits. Fishers can take up to 20 John dory as part of their combined daily bag limit in the Auckland and Kermadec, Central, and Challenger 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 John dory were calculated using an offsite approach, the offsite regional telephone and diary survey approach. Estimates for 1996 came from a national telephone and diary survey (Bradford 1998). Another national telephone and diary survey was carried out in 2000 (Boyd & Reilly 2004). The harvest estimates provided by these telephone diary surveys (Table 4) are no longer considered reliable.

In response to the cost and scale challenges associated with onsite methods, in particular the difficulties in sampling other than trailer boat fisheries, offsite approaches to estimating recreational fisheries harvest have been revisited. This led to the development and implementation of a national panel survey for the 2011–12 fishing year (Wynne-Jones et al 2014). The panel survey used face-to-face interviews of a random sample of New Zealand households to recruit a panel of fishers and non-fishers for a full year. The panel members were contacted regularly about their fishing activities and catch information in standardised phone interviews. The national panel survey was repeated during the 2017–18 and 2022–23 fishing years using very similar methods to produce directly comparable results (Wynne-Jones et al 2019; Heinemann & Gray, in prep). Recreational catch estimates from the three national panel surveys are given in Table 4. Note that national panel survey estimates do not include recreational harvest taken on charter vessel trips or under s111 general approvals.

Table 4: Recreational harvest estimates for John dory stocks. The telephone/diary surveys ran from December to November but are denoted by the January calendar year. National panel surveys ran throughout the October to September fishing year but are denoted by the January calendar year. Mean fish weights were obtained from boat ramp surveys (see Hartill & Davey 2015, Davey et al 2019; Davey et al in prep for panel survey mean weights).

Stock	Year	Method	Number of fish	Total weight (t)	CV
JDO 1	1996	Telephone/diary	49 000	87	0.09
	2000	Telephone/diary	129 000	227	0.23
	2012	Panel survey	26 198	32.6	0.14
	2018	Panel survey	21 295	24.8	0.20
	2023	Panel survey	4 813	6.1	0.29
JDO 2	2000	Telephone/diary	9 000	16	0.43
	2012	Panel survey	2 000	2.5	0.33
	2018	Panel survey	2 587	3.1	0.34
	2023	Panel survey	1 060	1.4	0.54
JDO 3	2012	Panel survey	88	< 1	1.00
	2018	Panel survey	183	< 1	1.00
	2023	Panel survey	-	-	-
JDO 7	2012	Panel survey	1 351	1.8	0.52
	2018	Panel survey	699	0.8	0.47
	2023	Panel survey	215	0.3	0.72

1.3 Customary non-commercial fisheries

No quantitative information is available on the current level of Māori customary non-commercial catch.

1.4 Illegal catch

No quantitative information is available.

1.5 Other sources of mortality

No quantitative information is available.

2. BIOLOGY

John dory are widespread, being found in the eastern Atlantic Ocean, the Mediterranean Sea, and around New Zealand, Australia, and Japan. They are common in the inshore coastal waters of northern New Zealand and, to a lesser extent in Tasman Bay, to depths of 50 m. In the Hauraki Gulf, adults move to deeper waters during summer and occasional feeding aggregations occur during winter.

John dory are serial spawners (spawning more than once in a season). There appears to be substantial variation in the time of spawning in New Zealand, with spawning occurring between December and April off the northeast coast. The eggs are large and pelagic, taking 12–14 days to hatch. Initially John dory grow rapidly with both males and females reaching 12 to 18 cm standard length (SL) after the first year. From the second year onwards females grow faster than males and reach a greater maximum length. Females mature at a size of 29 to 35 cm SL and in general, larger females mature earlier in the season and are more fecund. Males mature at 23 to 29 cm SL.

M was estimated using the equation $M = \log_e 100/\text{maximum age}$, where maximum age is the age to which 1% of the population survives in an unexploited stock. Using a maximum observed age of 12 years, M was estimated to equal 0.38. Biological parameters relevant to the stock assessment are given in Table 5.

Table 5: Estimates of biological parameters of John dory.

Fishstock	Estimate		Source
1.Weight = a (length)^b (Weight in g, length in cm total length)			
Combined sexes	a	b	
JDO 1	0.048	2.7	from *Ikatere* 2003

2. von Bertalanffy growth parameters

	Females			Males			
	K	t_0	$L\infty$	K	t_0	$L\infty$	
JDO 1	0.425	-0.223	41.13	0.48	-0.251	36.4	Hore (1982)

3. STOCKS AND AREAS

In 2012 the stock structure of John dory was reviewed (Dunn & Jones 2013). The approach evaluated patterns in the distribution of catch and CPUE, research survey biomass trends, location of spawning and nursery grounds, size and age compositions, and anecdotal information from the fishery.

John dory have been caught around most of the North Island and the northern South Island, indicating that the QMA boundaries are not biologically appropriate. The analysis suggested five stocks around New Zealand: (1) Hauraki Gulf and east Northland; (2) Bay of Plenty; (3) west coast North Island; (4) southeast North Island; and (5) northern South Island.

Spawning fish and nursery grounds are found in all five stocks. In addition, off the east coast North Island, CPUE analyses support the separation of the Hauraki Gulf, Bay of Plenty, and Hawke's Bay fisheries, and research trawl survey biomass estimates had different trends in Hauraki Gulf and the Bay of Plenty. Very few John dory are found south of Hawke's Bay on the southeast North Island, providing a gap between the east and west coast components of JDO 2. There is relatively strong evidence to separate the northeast and northwest coasts of JDO 1, including fishery CPUE analyses, length and age compositions, and research trawl survey biomass trends. The distribution of John dory off the west coast North Island is continuous between JDO 1 and the northern part of the west coast JDO 2, and the combination of these areas is also supported by CPUE analyses. There is evidence to separate the northern South Island from stocks to the north including the occurrence of unusually large fish off the northern South Island and CPUE analyses. John dory appear to reach the southern limit of their range off the north and northwest coasts of the South Island.

4. STOCK ASSESSMENT

4.1 Estimates of fishery parameters and abundance

An investigation into the stock structure of New Zealand John dory (Dunn & Jones 2013) supported five biological stocks: (1) Hauraki Gulf and east Northland, (2) Bay of Plenty, (3) west coast North Island, (4) southeast North Island, and (5) northern South Island. The first three stocks are found within JDO 1, the fourth consists of the east coast portion of JDO 2, and the fifth of JDO 7 and the portion of JDO 2 located off the south and east coast of the North Island.

JDO 1

Relative abundance indices have been obtained from trawl surveys of the Bay of Plenty, west coast North Island, and Hauraki Gulf within the JDO 1 Fishstock (Table 6, Figure 2). However, there was a change in the configuration of the trawl gear following the 1988 trawl survey. Modifications to the trawl gear may have resulted in a change in the catchability of John dory part way through the time series. Therefore, surveys conducted between 1982 and 1988 and from 1989 onwards should be considered separately for comparisons of biomass indices to be valid.

In 2022, the CPUE indices for the three sub-areas within JDO 1 (Hauraki Gulf and east Northland, Bay of Plenty, and west coast North Island) were updated to 2020–21 (McKenzie 2023). The catch and effort data set included individual bottom trawl records from trawls targeting a range of inshore finfish species (BAR, TAR, TRE, GUR, SNA, and JDO). The landed catch of John dory from a trip was allocated to the individual trawl records in proportion to the estimated catch. The analyses used a delta-lognormal CPUE model incorporating positive catch (lognormal) and presence/absence (binomial) components. In a previous analysis (Langley 2018), different trends were apparent between the lognormal and binomial CPUE models. Further investigation indicated that the differences may have been attributable to changes in the recording of smaller John dory catches over the time period. Potential biases introduced by changes in catch reporting are likely to be adequately accounted for by applying the delta-lognormal approach.

Table 6: Estimates of John dory biomass (t) from *Kaharoa* trawl surveys. Estimates are recruited biomass (length ≥ 25 cm TL) for trawl surveys around the North Island, and total biomass for the west coast South Island survey. For the west coast North Island trawl survey, core strata are north of New Plymouth.

Year	Trip code	Biomass (t)	CV(%)
Bay of Plenty			
1983	KAH8303	105	25
1985	KAH8506	91	15
1990	KAH9004	123	18
1992	KAH9202	213	12
1996	KAH9601	172	49
1999	KAH9902	148	15
2020	KAH2001	81	24
2021	KAH2101	92	22
Hauraki Gulf			
1984	KAH8421	136	16
1985	KAH8517	131	13
1986	KAH8613	100	19
1988	KAH8810	385	39
1989	KAH8917	206	20
1990	KAH9016	192	18
1992	KAH9212	166	37
1993	KAH9311	320	27
1994	KAH9411	221	13
1997	KAH9720	287	20
2000	KAH0012	188	29
2019	KAH1907	187	15
2020	KAH2006	156	31

Year	Trip code	Biomass (t)	CV(%)
West coast North Island (core strata)			
1989	KAH8918	237	12
1991	KAH9111	455	29
1994	KAH9410	116	31
1996	KAH9615	320	16
1999	KAH9915	182	9
2018	KAH1806	280	27
2019	KAH1906	229	20
2020	KAH2005	154	18
West coast South Island			
1992	KAH9204	102	29
1994	KAH9404	59	26
1995	KAH9504	27	36
1997	KAH9701	17	31
2000	KAH0004	141	16
2003	KAH0304	288	19
2005	KAH0503	222	14
2007	KAH0704	174	26
2009	KAH0904	269	23
2011	KAH1104	378	18
2013	KAH1305	231	21
2015	KAH1503	486	16
2017	KAH1703	431	12
2019	KAH1902	274	31
2021	KAH2103	227	16

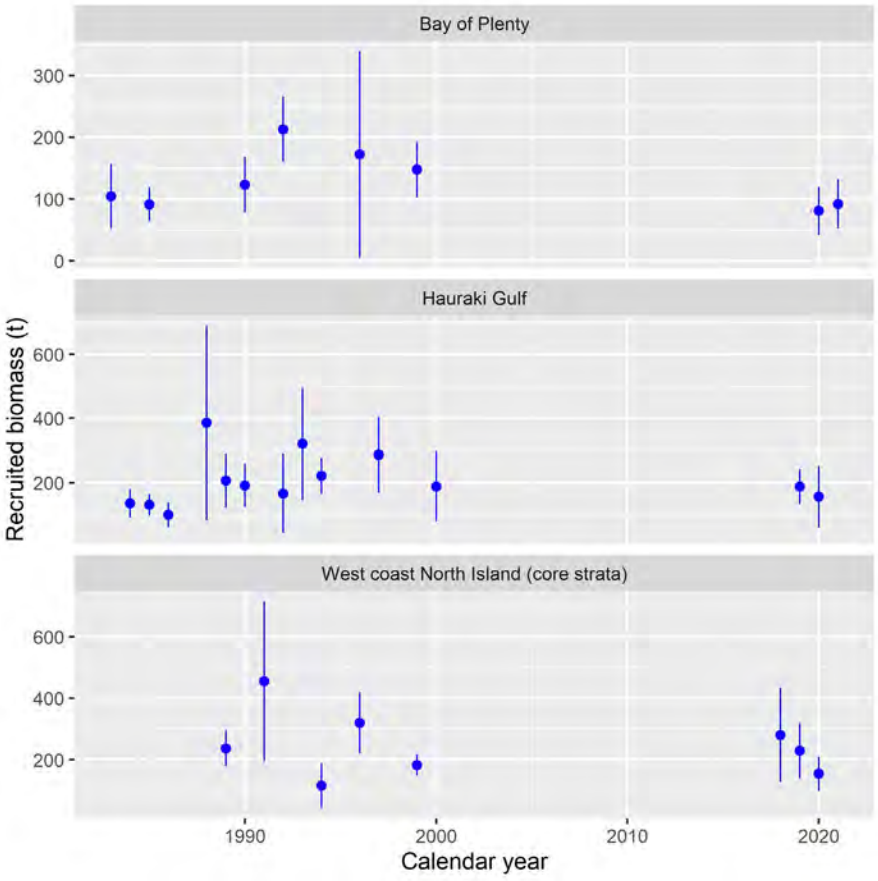


Figure 2: Estimates of recruited (length ≥ 25 cm) John dory biomass (t) from *Kaharoa* trawl surveys. Error bars are ± two standard deviations.

Hauraki Gulf and east Northland (HG, part of JDO 1)

In Hauraki Gulf and east Northland, the standardised CPUE indices fluctuated during the 1990s and 2000s, then steadily declined from 2004–05 to 2012–13, and then increased relatively slowly during 2013–14 to 2020–21 (Figure 3).

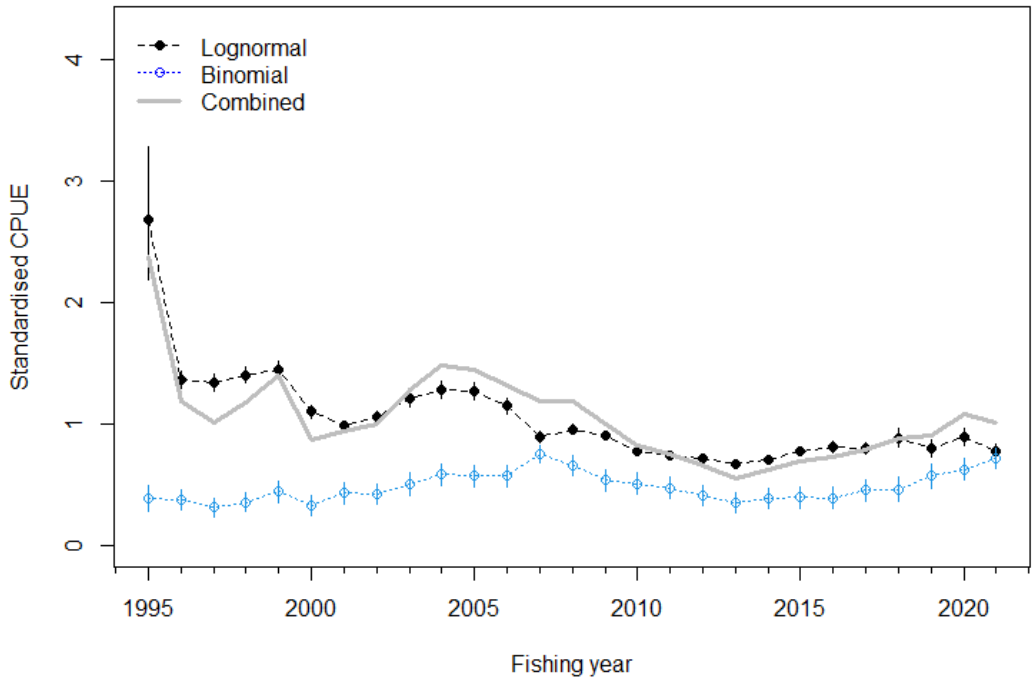


Figure 3: CPUE indices of abundance for Hauraki Gulf and east Northland (part of JDO 1) (combined model of catch rates in mixed species bottom trawl tows). Error bars are ± two standard deviations.

Bay of Plenty (BoP, part of JDO 1)

The standardised CPUE series declined during the late 1990s, remained relatively stable during the 2000s, dropped in 2012–13 to 2013–14, then increased from 2015–16 to 2016–17 to be above or close to the series mean, and then declined to 2019–20 and increased in 2020–21 (Figure 4).

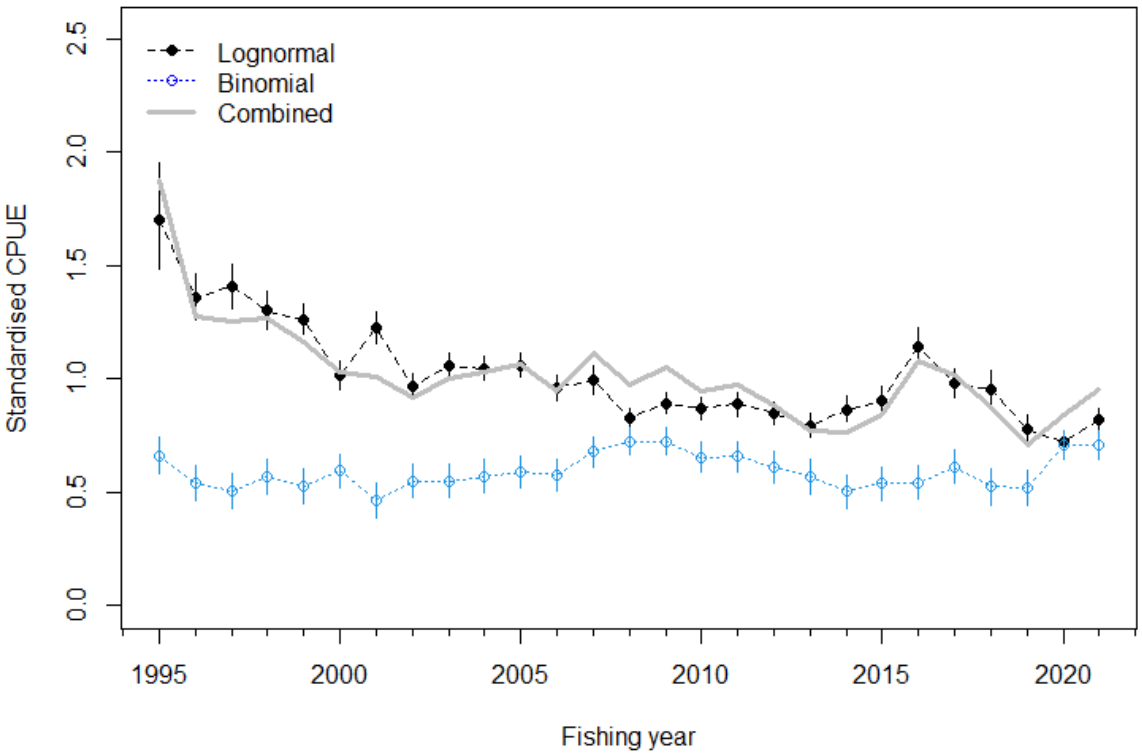


Figure 4: CPUE indices of abundance for the Bay of Plenty (part of JDO 1) (combined model of catch rates in mixed species bottom trawl tows). Error bars are ± two standard deviations.

West coast North Island (WCNI, western JDO 1 and western JDO 2)

The standardised CPUE series suggests that biomass has fluctuated over the study period. CPUE indices were at a high level in 2010–11 to 2012–13, declined over the subsequent four years (to 2016–17) to below the series mean, then slowly increased after this to be at the series mean in 2020–21 (Figure 5).

Establishing B_{MSY}-compatible reference points for JDO 1

In 2012, the Working Group accepted arithmetic mean standardised bottom trawl CPUE for the period 1995–96 to 2010–11 as B_{MSY}-compatible proxies for each of the three JDO 1 sub-stocks. All three series were based on combined positive catch and probability of capture models derived from event-scale fishing events (i.e., tow). JDO abundance tends to fluctuate in cycles, according to recruitment, and the period chosen included two periods of high abundance and high catch. 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 for each sub-stock, respectively.

Future Research Considerations:

- Consider constructing a pseudo-CELR series that goes back to 1989–90 to increase overlap of CPUE with WCNI, HG, and BoP trawl survey series.

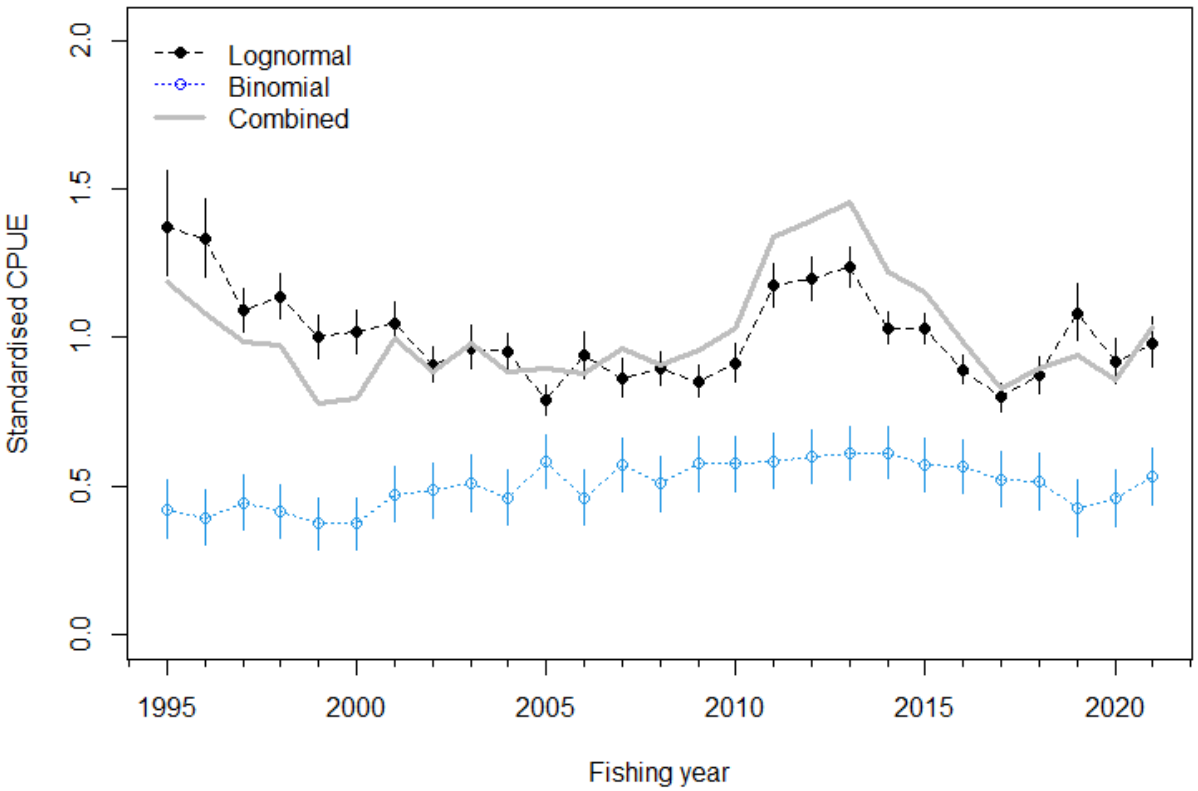


Figure 5: CPUE indices of abundance for the West coast North Island (western JDO 1 and western JDO 2) (combined model of catch rates in mixed species bottom trawl tows). Error bars are ± two standard deviations.

Southeast North Island (eastern part of JDO 2)

In 2013, standardised CPUE indices were derived from inshore trawlers operating in the eastern portion of JDO 2 for 1989–90 to 2010–11.

In 2022, the CPUE analysis was updated and refined to include data to 2021–22 (Langley 2023). The CPUE data set included bottom trawl trips that predominantly targeted red gurnard or tarakihi within Statistical Areas 011–014. Prior to 2007–08, catch and effort data were primarily collected in daily aggregate format (CELR). John dory catches are typically small and were frequently not reported amongst the catch of the five main species associated with the daily fishing effort. The CPUE data set was configured as an aggregated trip record with the associated landed catch of John dory and the aggregated fishing effort data (number of days fished, total number of trawls and trawl duration) and the predominant target species and Statistical Area (trip 'roll up').

The final CPUE data set was limited to a selection of core fishing vessels conducting a minimum of 20 trawls in at least 5 years. A GLM approach was applied to model the occurrence of John dory in the (trip) catch (binomial model) and the magnitude of positive John dory catches (lognormal model) to derive a combined CPUE index (delta-lognormal). The resulting series was similar to the previous analysis for the corresponding period.

The CPUE indices showed a cyclical pattern during the 1990s and early 2000s with a substantial peak in abundance during 1998–99 to 2001–02. The CPUE indices declined to a nadir in 2010–11 and 2011–12 and then steadily increased over the following years (Figure 6).

Establishing B_{MSY}-compatible reference points for east coast portion JDO 2 (FMA 2)

In 2013, the Working Group accepted the arithmetic mean standardised bottom trawl CPUE for the period 1989–90 to 2010–11 as a B_{MSY}-compatible proxy for the east coast JDO 2 stock. JDO abundance tends to fluctuate in cycles, according to recruitment, and the period chosen included two periods of high abundance and high catch and two periods of low abundance and catch, i.e., two

cycles. 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.

Future Research Considerations:

- Potential stock linkages between Bay of Plenty (JDO 1) and the eastern portion of JDO 2 (FMA2).

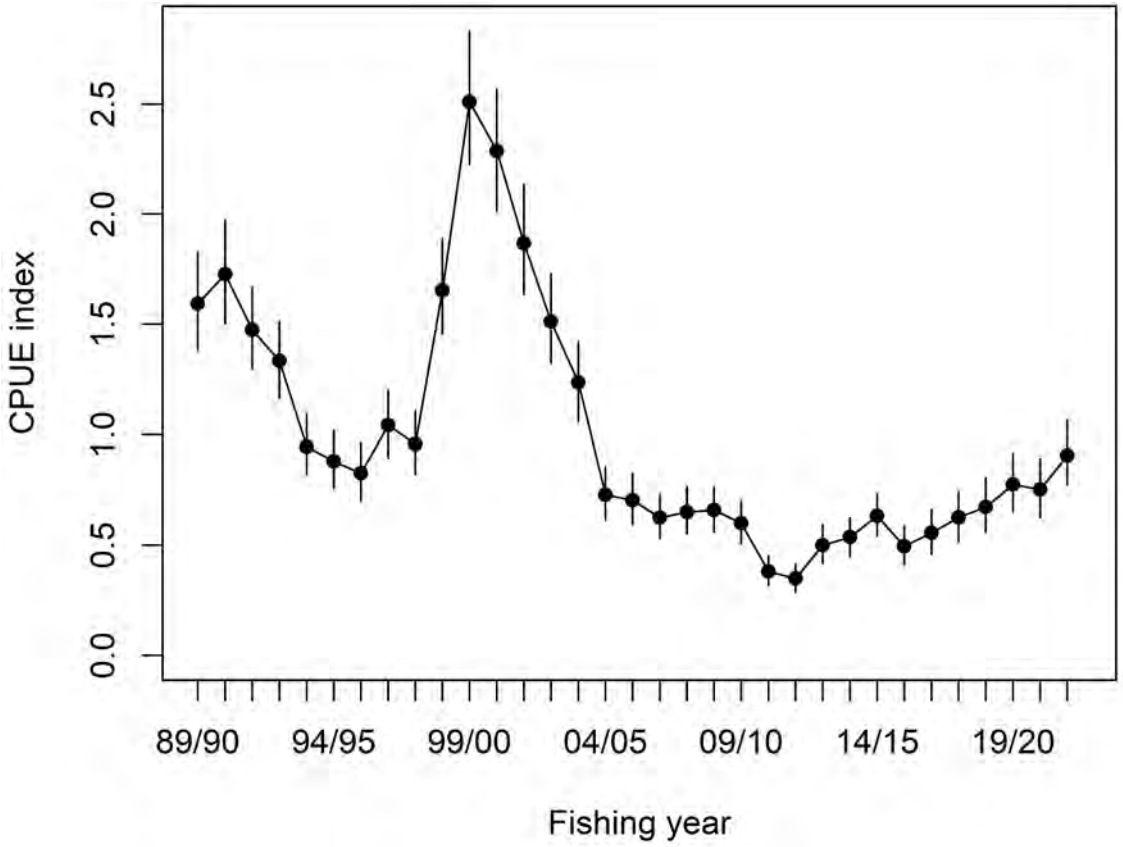


Figure 6: CPUE indices for the Southeast North Island (part of JDO 2). Vertical lines show the 95% confidence intervals. Scaled to the average of the entire series.

Northern South Island (JDO 7 and southern part of JDO 2)

In 2014, the CPUE indices for the northern South Island zone (JDO 7 and part of JDO 2) were revised and updated to include data to 2012–13 (Langley 2014). The CPUE index was based on JDO bycatch from the following bottom trawl targets: BAR, FLA, GUR, JDO, JMA, RCO, and TAR, in Statistical Areas 033–039.

The Southern Inshore Working Group agreed that the west coast South Island (WCSI) inshore trawl survey series appears to monitor trends in abundance of John dory, particularly recruited biomass (defined as fish of at least 25 cm TL) (Figure 7). The John dory biomass estimate of 227 t in 2021 had declined from the time series highs in 2015 and 2017 but was above the time series mean of 222 t (Table 6). Biomass was low in the 1990s and increased from the 2000s, peaking in 2015. In most years, more biomass has been from the west coast, but more came from Tasman Bay and Golden Bay in 2021 (MacGibbon et al 2022). Biomass decreased for the west coast but increased slightly in Tasman Bay and Golden Bay—the long-term trend in the bays has been fairly constant.

Length frequencies in the 1990s were generally unclear although small but distinct 1+ cohorts could be seen in 1992 and 1994. The large increase in biomass seen in the 2000s coincided with larger and more distinct modes seen in the length frequency distribution, particularly (though not exclusively) with 1+ fish which have been distinct in a number of years since 2000 (e.g., 2000, 2003, 2009, 2015, 2017, and 2021). In fact, the 2021 length frequency distribution shows the strongest 1+ mode in the time series from Tasman Bay and Golden Bay at around 24–34 cm (Figure 8). In 2017, the length frequency distribution showed a strong 1+ mode at 21–32 cm, which was stronger than the 1+ mode

from any previous survey in the series at that time. However, this did not translate into higher recruited biomass in 2019 (Figure 7). The right-hand tail of the distribution had lower numbers of fish than surveys with weaker modes, and the biomass decreased in both regions between 2017 and 2019. The 2019 1+ mode appears to have come through as 3+ fish at around 35–42 cm in 2021 for Tasman Bay and Golden Bay with fish above this size likely comprising multiple year classes, and recruited biomass remains relatively high here (Figure 7). However, recruited biomass off the west coast in 2021 was lower than in 2019. The west coast 1+ fish have been typically weaker than in Tasman Bay and Golden Bay. John dory numbers overall are down in 2021, mainly in the right-hand tail.

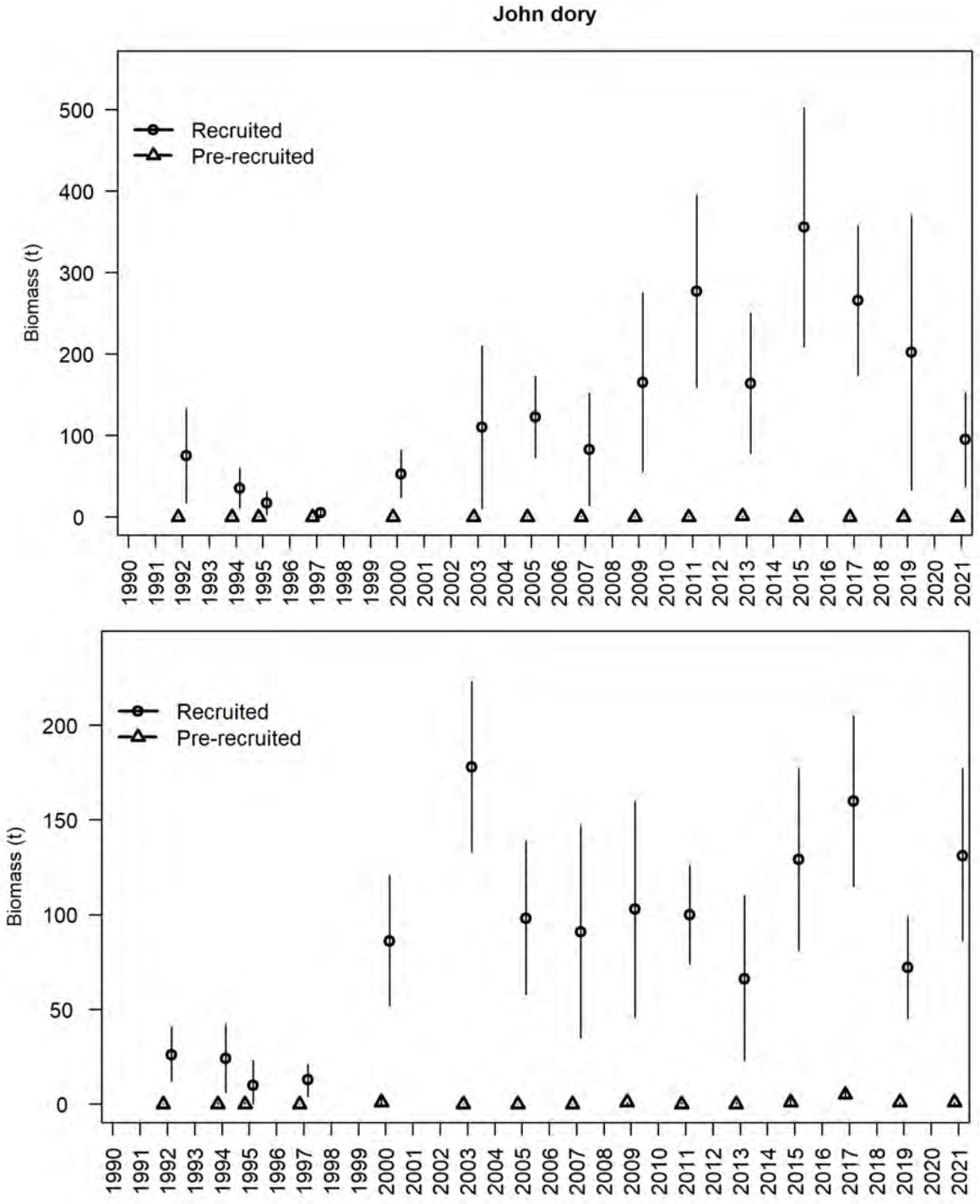


Figure 7: WCSI inshore trawl survey biomass estimates of recruited and pre-recruit John dory for the west coast South Island strata (top plot) and Tasman Bay/Golden Bay strata (bottom plot). Error bars are ± two standard deviations. John dory are assumed to recruit to the commercial fishery at 25 cm TL.

The standardised CPUE series shows a similar trend to the trawl survey biomass index, with a large increase in biomass between the late 1990s and early 2000s, which persisted to 2013 (Figure 9).

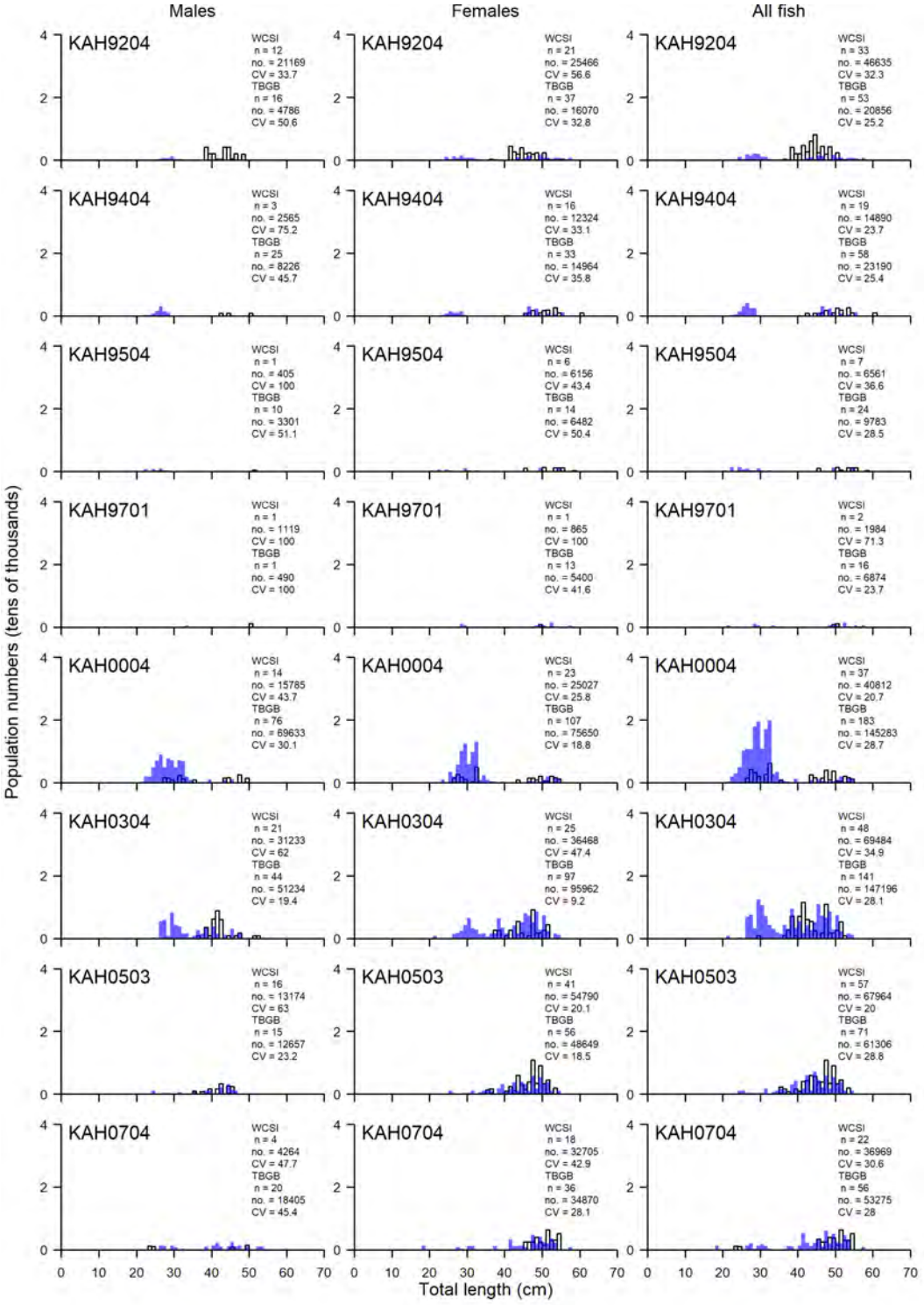


Figure 8: Scaled population length frequency distributions for John dory in 30–400 m for west coast (white bars) and Tasman Bay/Golden Bay (blue bars), from WCSI surveys. n = number of fish measured, no. = scaled population number, CV = coefficient of variation (%). [Continued on next page]

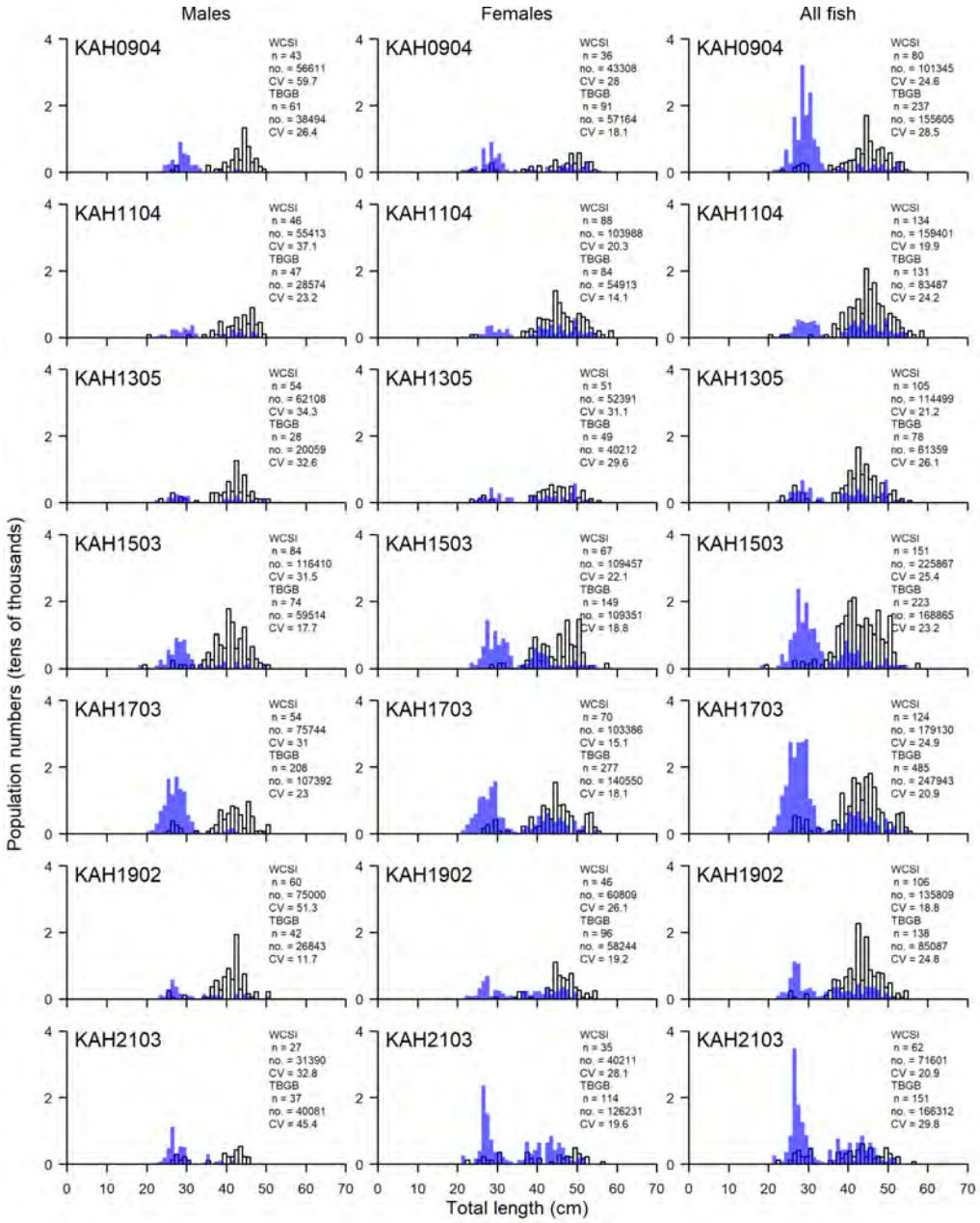


Figure 8 [Continued]: Scaled population length frequency distributions for John dory in 30–400 m for west coast (white bars) and Tasman Bay/Golden Bay (blue bars), from WCSI surveys. n = number of fish measured, no. = scaled population number, CV = coefficient of variation (%).

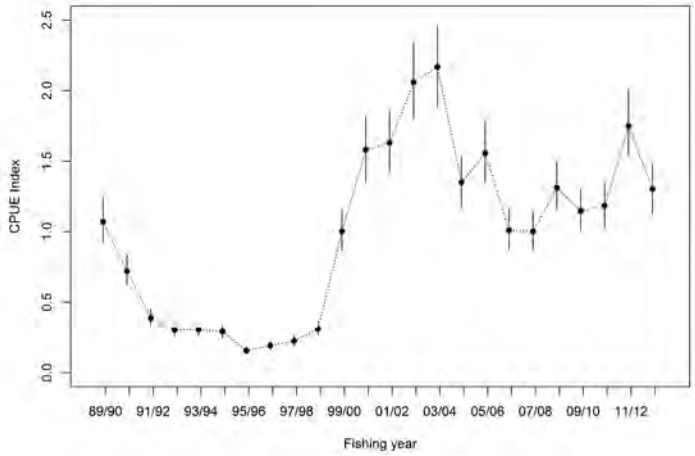


Figure 9: CPUE indices of abundance for the northern South Island (JDO 7 and part of JDO 2), combined model of catch rates in mixed species bottom trawl tows (Langley 2014). Vertical lines show the 95% credible intervals.

4.2 Biomass estimates

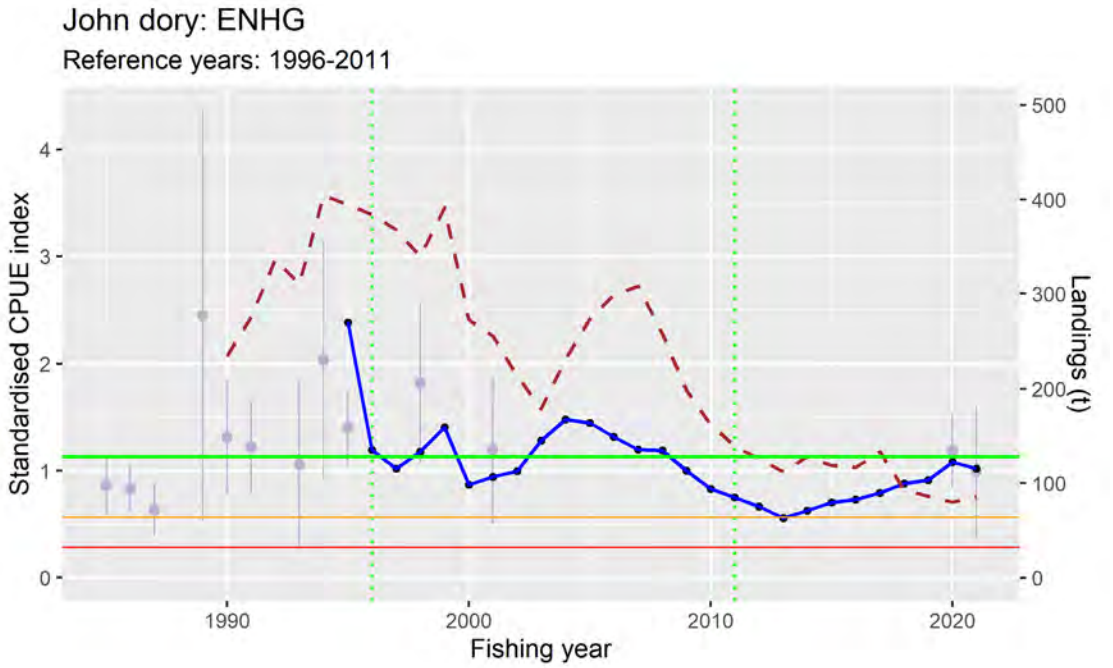
Estimates of absolute reference and current biomass are not available.

5. STATUS OF THE STOCKS

- **JDO 1 (Hauraki Gulf and east Northland)**

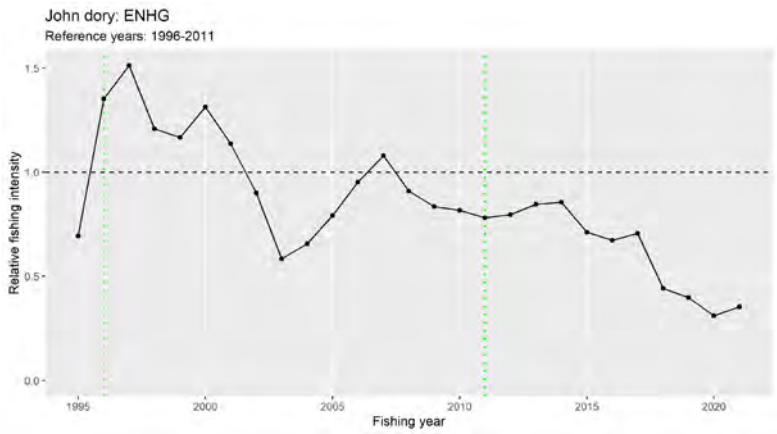
Stock Status		
Most Recent Assessment Plenary Publication Year	2022	
Catch in most recent year of assessment	Year: 2020–21	Catch: 86 t
Assessment Runs Presented	Standardised CPUE	
Reference Points	Interim Target: Arithmetic mean of the CPUE indices for John dory in Hauraki Gulf and east Northland from combined binomial and lognormal models from 1995–96 to 2010–11 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	Very Unlikely (< 10%) that overfishing is occurring	

Historical Stock Status Trajectory and Current Status



Standardised CPUE indices for John dory in Hauraki Gulf and east Northland from combined binomial and lognormal models of catch rate in bottom trawl tows in a mixed target fishery (blue line). Solid horizontal lines indicate the target (green), soft limit (orange), and hard limit (red). The commercial catch from the area is also presented (dashed brown line), and trawl survey recruited biomass indices (purple with error bars ± two standard deviations).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The CPUE indices steadily declined from the mid-2000s to slightly below the soft limit in 2012–13, then increased to be just below the target in 2019–20 and 2020–21.

Recent Trend in Fishing Intensity or Proxy	 **Relative fishing mortality proxy derived from total area catch divided by CPUE indices from the recent CPUE analysis (black points). The dashed horizontal line represents the average fishing mortality in the period used to define the reference points (vertical green dotted lines).** The fishing mortality proxy indicates that fishing mortality has declined since 2006–07. Since 2011–12, total catch has remained stable or declined, while CPUE has increased, leading to a decrease in the fishing mortality proxy.
Other Abundance Indices	There is good correspondence between the Hauraki Gulf trawl survey and CPUE series.
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Annual catches and fishing mortality have been relatively low since 2011–12. There has been an approximate doubling of CPUE indices since 2011–12 and the 2020–21 CPUE index is just below target.
Probability of Current Catch or TAC causing Biomass to remain below or to decline below Limits	Soft Limit: Unlikely (< 40%) at the current catch levels (which are the lowest of the time series) Hard Limit: Very Unlikely (< 10%) over the next five years at current catch levels
Probability of Current Catch or TAC causing Overfishing to continue or to commence	Current catch is Very Unlikely (< 10%) to cause overfishing

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE	
Assessment Dates	Latest assessment Plenary publication year: 2022	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	-	

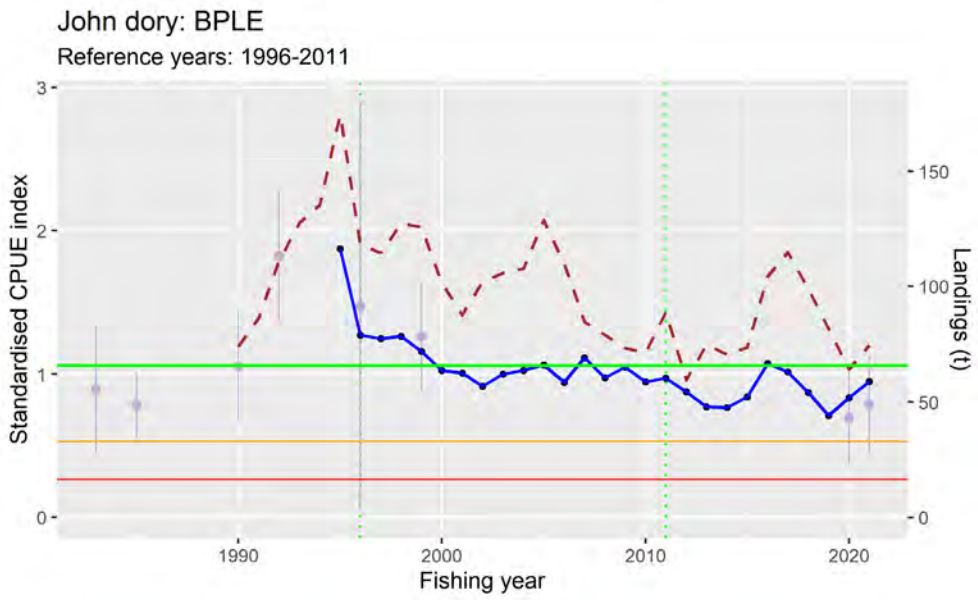
Qualifying Comments
-

Fishery Interactions
John dory is taken on the east coast by bottom trawl and Danish seine targeted at John dory and snapper.

- **JDO 1 (Bay of Plenty)**

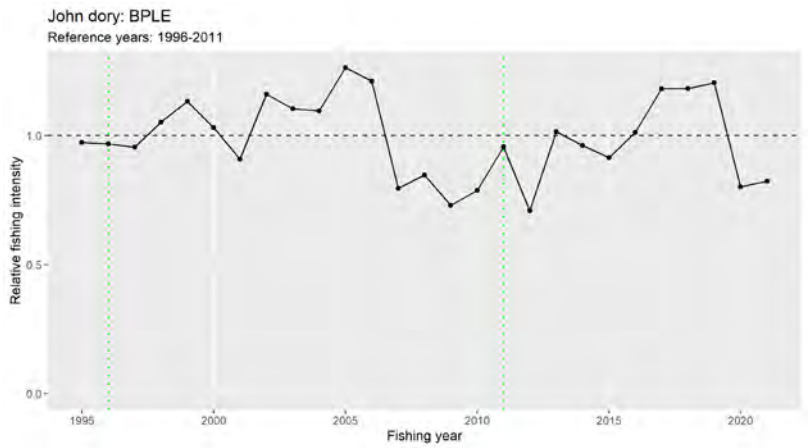
Stock Status		
Most Recent Assessment Plenary Publication Year	2022	
Catch in most recent year of assessment	Year: 2020–21	Catch: 75 t
Assessment Runs Presented	Standardised CPUE	
Reference Points	Interim Target: Arithmetic mean of the CPUE indices for John dory in Bay of Plenty from combined binomial and lognormal models from 1995–96 to 2010–11 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	Unlikely (< 40%) that overfishing is occurring	

Historical Stock Status Trajectory and Current Status



Standardised CPUE indices for John dory in Bay of Plenty from combined binomial and lognormal models of catch rate in bottom trawl tows in a mixed target fishery (blue line). Solid horizontal lines indicate the target (green), soft limit (orange), and hard limit (red). The commercial catch from the area is also presented (dashed brown line), and trawl survey recruited biomass indices (purple with error bars ± two standard deviations).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The CPUE indices declined to minimum in 2018–19 and increased after that to be slightly below target in 2020–21.

Recent Trend in Fishing Mortality or Proxy	 **Relative fishing mortality proxy derived from total area catch divided by CPUE indices from the recent CPUE analysis (black points). The dashed horizontal line represents the average fishing mortality in the period used to define the reference point (vertical green dotted lines).** The fishing mortality proxy was a minimum in 2011–12, increased to be above the threshold (F_{MSY} proxy) level from 2016–17 to 2018–19, then declined to be below the reference for the last two years.
Other Abundance Indices	There is good correspondence between the Bay of Plenty trawl survey and CPUE series.
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	From 2018–19 annual catches have been relatively low, and the CPUE indices have increased. The current lower level of the fishing mortality may cause the stock to increase.
Probability of Current Catch or TAC causing Biomass to remain below or to decline below Limits	Soft Limit: Unlikely (< 40%) at current catch levels Hard Limit: Very Unlikely (< 10%) at current catch levels
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unlikely (< 40%) at the current level of catch

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Fishery characterisation and standardised CPUE	
Assessment Dates	Latest assessment Plenary publication year: 2022	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	2022 CPUE analysis	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-	

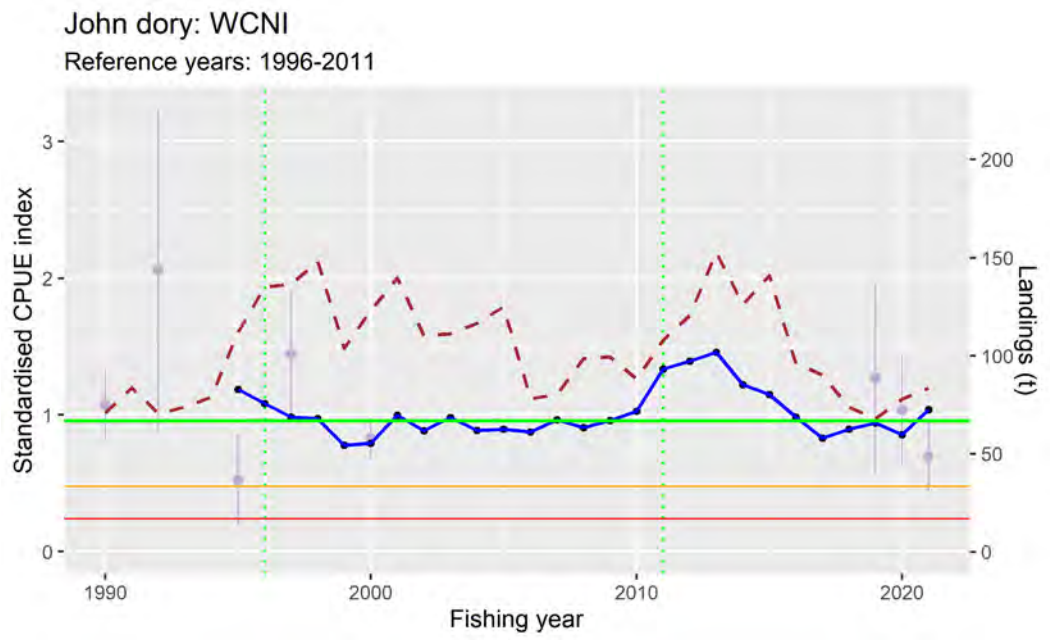
Qualifying Comments
-

Fishery Interactions
John dory is taken in the Bay of Plenty by bottom trawl targeted at John dory, snapper, trevally, tarakihi, and red gurnard and by Danish seine targeted at snapper and red gurnard.

- **JDO 1 (West Coast North Island)**

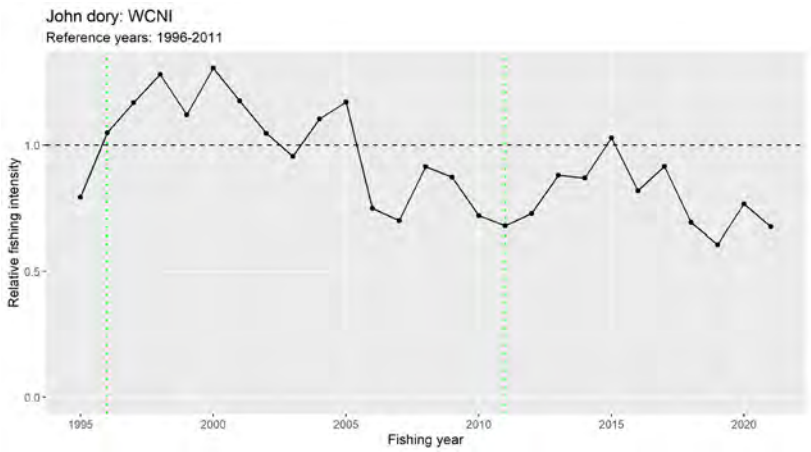
Stock Status		
Most Recent Assessment Plenary Publication Year	2022	
Catch in most recent year of assessment	Year: 2020–21	Catch: 83 t
Assessment Runs Presented	Standardised CPUE	
Reference Points	Interim Target: Arithmetic mean of the CPUE indices for John dory on West Coast North Island from combined binomial and lognormal models from 1995–96 to 2010–11 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	Unlikely (< 40%) to be occurring	

Historical Stock Status Trajectory and Current Status



Standardised CPUE indices for John dory in west coast North Island from combined binomial and lognormal models of catch rate in bottom trawl tows in a mixed target fishery (blue line). Solid horizontal lines indicate the target (green), soft limit (orange), and hard limit (red). The commercial catch from the area is also presented (dashed brown line), and trawl survey recruited biomass indices (purple with error bars ± two standard deviations).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	From 2016–17 the CPUE indices have increased to be just above target in 2020–21.

Recent Trend in Fishing Intensity or Proxy	 **Relative fishing mortality proxy derived from total area catch divided by CPUE indices from the recent CPUE analysis (black points). The dashed horizontal line represents the average fishing mortality in the period used to define the reference points (vertical green dotted lines).** Fishing mortality increased to the threshold during 2014–15 and then declined to be below the threshold in 2020–21.
Other Abundance Indices	There is good correspondence between the WCNI trawl survey and CPUE series
Trends in Other Relevant Indicators or Variables	-

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

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Fishery characterisation and standardised CPUE	
Assessment Dates	Latest assessment Plenary publication year: 2022	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	2022 CPUE analysis	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- The stock relationship between JDO 1 and JDO 2	

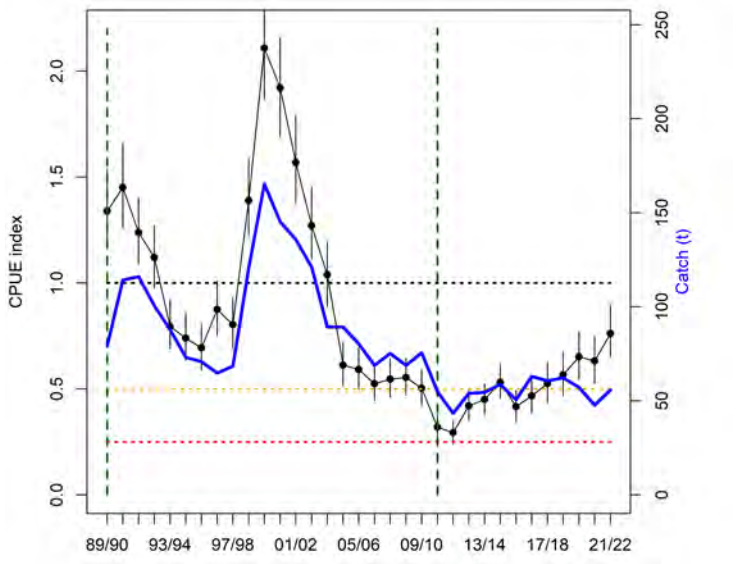
Qualifying Comments
-

Fishery Interactions
John dory is taken off the west coast by bottom trawl targeted at snapper trevally, gurnard, and tarakihi.

- **JDO 2 (Southeast North Island – FMA2)**

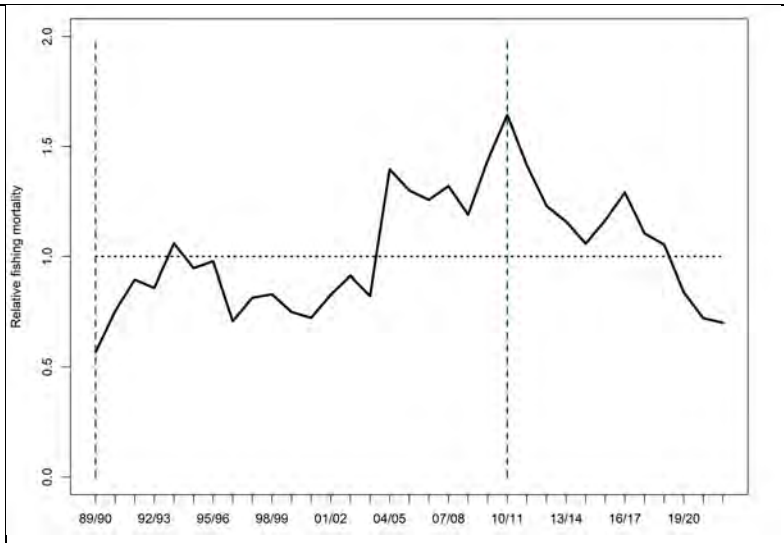
Stock Status		
Most Recent Assessment Plenary Publication Year	2023	
Catch in most recent year of assessment	Year: 2021–22	Catch: 56 t
Assessment Runs Presented	Standardised CPUE (Trip-based BT targeting JDO, TAR, GUR)	
Reference Points	Interim target = B_{MSY} proxy: Mean of the CPUE indices for John dory off the southeast coast of the North Island from combined binomial and lognormal models from 1989–90 to 2010–11 Soft Limit: 50% of target Hard Limit: 25%of target Overfishing threshold = F_{MSY} proxy: Mean relative exploitation rate for period 1989–90 to 2010–11	
Status in relation to Target	Unlikely (< 40%) 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	Unlikely (< 40%) to be occurring	

Historical Stock Status Trajectory and Current Status



Standardised CPUE indices for John dory in Southeast North Island. Dashed horizontal lines represent the target and associated soft and hard limits. The blue line represents catch from this area.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The CPUE indices have increased steadily from a low level in 2010–11 and 2011–12.

Recent Trend in Fishing Intensity or Proxy	 **Relative fishing mortality proxy derived from total area catch divided by CPUE indices (black points). The dashed horizontal line represents the average fishing mortality in the period used to define the reference points (vertical green dotted lines).** Fishing mortality declined over the last decade and is currently below the threshold.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Without information on recruitment, it is not possible to predict how the stock will respond in the next few years.
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Current catch: Soft Limit: Unlikely (< 40%) Hard Limit: Very Unlikely (< 10%) Current TACC: The TACC applies to both east and west coasts of JDO 2. About half of the catch for JDO 2 comes from the east coast stock. The total catch for JDO 2 is currently about one third of the TACC.
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unlikely (< 40%) at current level of catch.

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Fishery characterisation and standardised CPUE	
Assessment Dates	Latest assessment Plenary publication year: 2023	Next assessment: 2026
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	The 2023 assessment update reduced the number of target species (TAR, GUR, JDO) and Statistical Areas to 011–014.	
Major Sources of Uncertainty	-	

Qualifying Comments
-

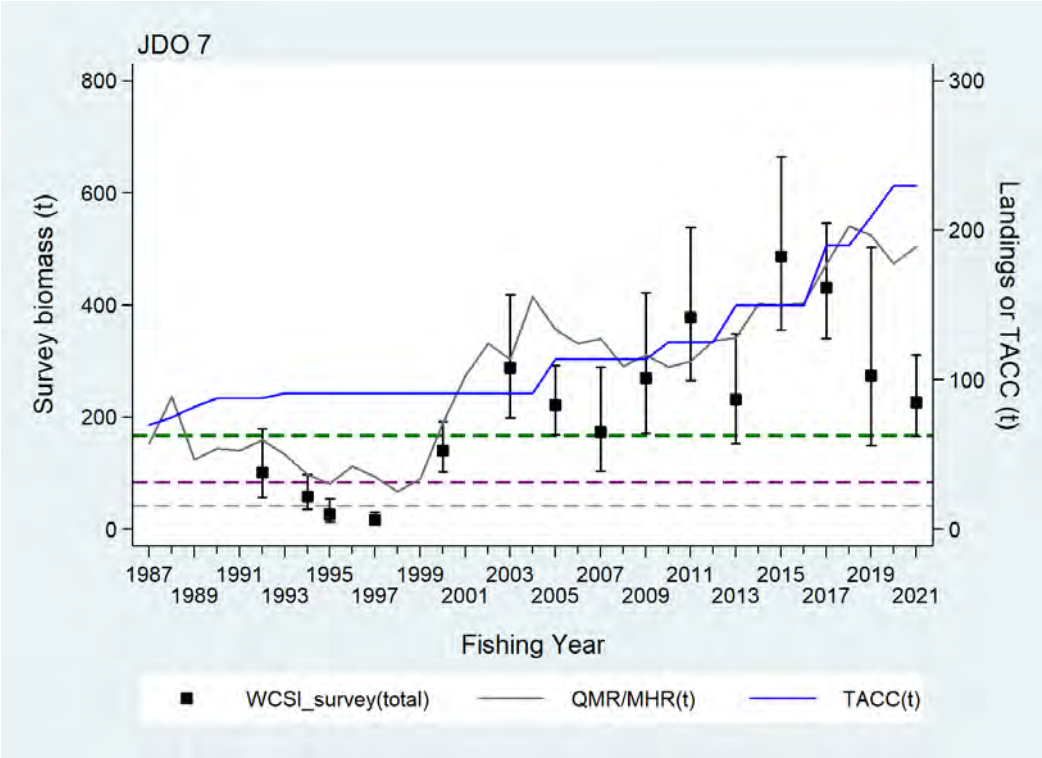
Fishery Interactions

John dory is taken off the east coast by bottom trawl primarily targeting tarakihi and red gurnard.

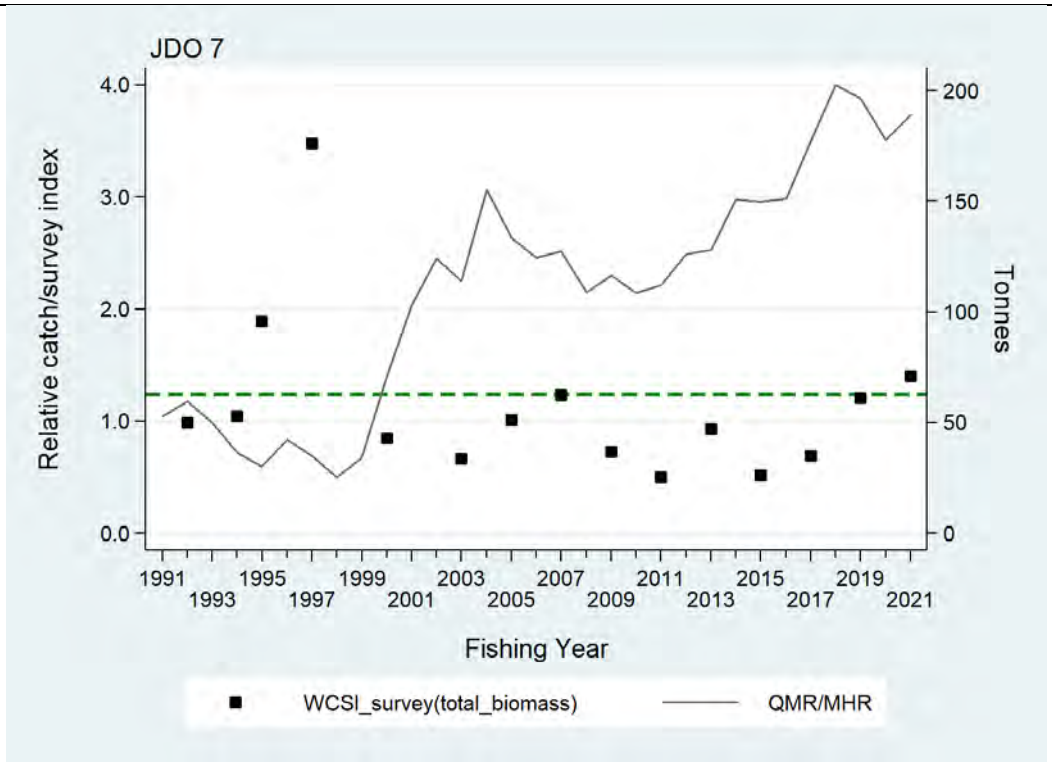
- **JDO 7 (Northern South Island)**

Stock Status		
Most Recent Assessment Plenary Publication Year	2022	
Catch in most recent year of assessment	Year: 2020–21	Catch: 189 t
Assessment Runs Presented	Trawl survey biomass index (2021) and standardised CPUE (2014)	
Reference Points	Interim Target: Arithmetic mean of total biomass from the West Coast South Island trawl survey (WCSI and TBGB) from 1992 to 2011 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: 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



Biomass trends from the west coast South Island inshore trawl survey time series. Error bars are ± two standard deviations, assuming a lognormal distribution. The agreed B_{MSY} proxy (arithmetic average: 1992–2011 WCSI survey biomass estimates=168 t) is shown as a green dashed line; the calculated Soft Limit (=50% B_{MSY} proxy) is shown as a purple dashed line; the calculated Hard Limit (=25% B_{MSY} proxy) is shown as a grey dashed line.



Relative fishing pressure for JDO 7 based on the ratio of QMR/MHR landings to the corresponding WCSI total biomass trawl survey index which has been normalised so that the geometric mean=1.0 overall index values. Horizontal green dashed line is the arithmetic mean fishing pressure from 1992 to 2011 (1.239).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The series has been at or above the agreed B_{MSY} proxy since the 2003 survey. However, recent index values have declined steadily since 2015, the highest observed index value.
Recent Trend in Fishing Intensity or Proxy	Commercial catch has tracked a rising TACC since 2010, when catches were 109 t to the four years from 2018 to 2021, when catches averaged 192 t/y.
Other Abundance Indices	The trend in BT CPUE (1989–90 to 2012–13) is comparable with that for trawl survey series.
Trends in Other Relevant Indicators or Variables	- Length frequency analysis from the west coast South Island inshore trawl survey showed very good recruitment in 2000, 2003, and 2009 and these are probably supporting the high biomass at that time. - Recruitment from the 2011 and 2013 surveys was more modest but recruitment was again high in 2015 and 2017. Recruitment appears to be modest again in 2019. The 2021 recruitment is greater than seen in 2019, especially for females, but does not approach the high levels seen in 2015 and 2017.

Projections and Prognosis	
Stock Projections or Prognosis	The stock was near the B_{MSY} proxy target biomass level in 2020–21, and previous high catches appear to have been sustained by good recruitment. The 2021 recruitment appears to be average or slightly above average.
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Very Unlikely (< 10%)
Probability of Current Catch or TACC causing Overfishing to continue or to commence	About as Likely as Not (40–60%), for current catch and Unknown for TACC

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Evaluation of survey biomass and length frequencies and standardised CPUE	
Assessment Dates	Latest assessment Plenary publication year: 2022 (Survey) 2014 (CPUE)	Next assessment: 2024 (survey)
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- West Coast South Island trawl survey - Survey length frequency - CPUE	1 – High Quality 1 – High Quality 1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- The stock relationship between JDO 7 and the western part of JDO 2	

Qualifying Comments
-

Fishery Interactions
John dory are primarily taken in conjunction with the following QMS species: barracouta, red cod, stargazer, red gurnard, snapper, and tarakihi in the Northern South Island bottom trawl fishery.

6. FOR FURTHER INFORMATION

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

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Davey, N; Hartill, B; Carter, M (2019). Mean weight estimates for recreational fisheries in 2017–18. *New Zealand Fisheries Assessment Report 2019/25*. 32 p.

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