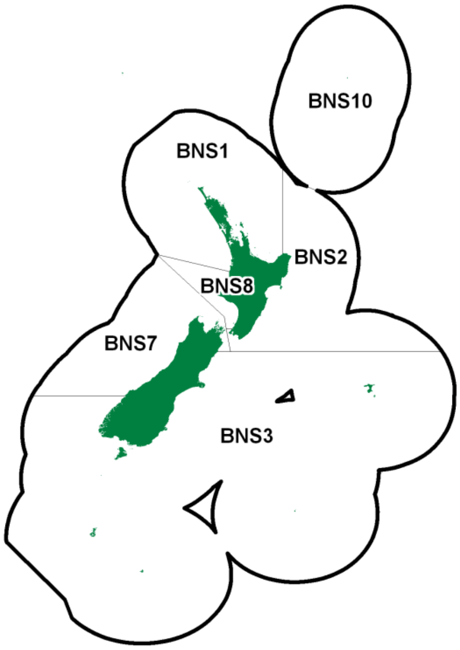
BLUENOSE (BNS)

(Hyperoglyphe antarctica)
Matiri



1. FISHERY SUMMARY

Bluenose were introduced into the QMS on 1 October 1986. A Total Allowable Catch (TAC) was set under the provisions of the 1983 Fisheries Act, initially at 1350 t. In 2010 new TACs were set for all BNS stocks along with recreational allowances, customary non-commercial allowances, and allowances for other sources of mortality. All current allowances, TACCs, and TACs are given in Table 1.

Table 1: Recreational and customary non-commercial allowances, TACCs, and TACs by Fishstock (t) for bluenose.

Fishstock	Recreational allowance	Customary allowance	Other mortality	TACC	TAC
BNS 1	15	2	8	230	251
BNS 2	25	2	9	247	279
BNS 3	18	2	3	93	114
BNS 7	3	2	2	34	40
BNS 8	2	1	1	16	20
BNS 10	–	–	–	10	10

1.1 Commercial fisheries

Bluenose have been landed since the 1930s, although the target line fishery for bluenose only developed in the late 1970s, with the trawl fishery off the lower east coast of the North Island developing after 1983, initially as a bycatch of the alfonsino fishery (Horn 1988a). The largest domestic bluenose fisheries occur in BNS 1 and 2. Historically, catches in BNS 2 were predominantly taken in the target alfonsino and bluenose trawl fisheries, but have been primarily taken by target bottom longline fishing in recent years. There is a target line fishery for bluenose in the Bay of Plenty and off Northland (both BNS 1). Target line fisheries for bluenose also exist off the west coast of the South Island (BNS 7) and the central west coast of the North Island (BNS 8). Bluenose in BNS 7 are also taken as bycatch in the hoki trawl and ling line fisheries. The BNS 3 fishery is focused on the eastern Chatham Rise where bottom longline catches were historically a bycatch of ling and hāpuku target fisheries. Target bluenose lining has predominated since 2003–04. There has been a consistent bycatch of bluenose in the alfonsino target bottom trawl fishery and bluenose have been targeted sporadically in a midwater trawl fishery in BNS 3 since the early 2000s. The bottom trawl fishery in BNS 3 has diminished. A small amount of target set net fishing for bluenose occurred in the Bay of Plenty until 1999 and again since 2012. Target bluenose set net fishing also occurs sporadically in the

Wairarapa region of BNS 2. Set net catches off the east coast of the South Island have been a mix of target and bycatch in ling and hāpuku target sets. There was a dahn line fishery capturing between 9 and 65 tonnes/year of bluenose in Statistical Areas 031 and 032 (Fiordland) during the mid-1990s to the mid-2000s. Reported landings and TACCs since 1981 are given in Table 2, and the historical landings and TACC for the main BNS stocks are depicted in Figure 1.

Table 2: Reported landings (t) of bluenose by Fishstock from 1981 to present and actual TACCs (t) from 1986–87 to present. QMS data from 1986 to present. [Continued on next page]

Fish stock	BNS 1		BNS 2		BNS 3		BNS 7		BNS 8	
FMA (s)	1 & 9		2		3, 4, 5 & 6		7		8	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1981*	146	–	101	–	36	–	12	–	–	–
1982*	246	–	170	–	46	–	22	–	–	–
1983†	250	–	352	–	51	–	47	–	1	–
1984†	464	–	810	–	81	–	30	–	1	–
1985†	432	–	745	–	73	–	26	–	1	–
1986†	440	–	1 009	–	33	–	53	–	1	–
1986–87	286	450	953	660	93	150	71	60	1	20
1987–88	405	528	653	661	101	166	104	62	1	22
1988–89	480	530	692	768	90	167	135	69	13	22
1989–90	535	632	766	833	132	174	105	94	3	22
1990–91	696	705	812	833	184	175	72	96	5	22
1991–92	765	705	919	839	240	175	62	96	5	22
1992–93	787	705	1 151	842	224	350	120	97	24	22
1993–94	615	705	1 288	849	311	350	79	97	27	22
1994–95	706	705	1 028	849	389	357	83	150	79	100
1995–96	675	705	953	849	513	357	140	150	70	100
1996–97	966	1 000	1 100	873	540	357	145	150	86	100
1997–98	1 020	1 000	929	873	444	357	123	150	67	100
1998–99	868	1 000	1 002	873	729	357	128	150	46	100
1999–00	860	1 000	1 136	873	566	357	114	150	55	100
2000–01	890	1 000	1 097	873	633	357	87	150	14	100
2001–02	954	1 000	1 010	873	+733	+925	70	150	17	100
2002–03	1 051	1 000	933	873	+876	+925	76	150	66	100
2003–04	1 030	1 000	933	873	915	925	117	150	96	100
2004–05	870	1 000	1 162	1 048	844	925	94	150	42	100
2005–06	699	1 000	1 136	1 048	536	925	84	150	20	100
2006–07	742	1 000	957	1 048	511	925	164	150	50	100
2007–08	585	1 000	1 055	1 048	660	925	145	150	53	100
2008–09	627	786	864	902	444	505	80	89	31	43
2009–10	665	786	845	902	419	505	94	89	36	43
2010–11	623	786	560	902	411	505	75	89	27	43
2011–12	417	571	431	629	256	248	94	89	20	43
2012–13	368	400	449	438	245	171	53	62	26	29
2013–14	382	400	435	438	248	171	60	62	28	29
2014–15	407	400	441	438	175	171	61	62	20	29
2015–16	344	400	386	438	172	171	52	62	7	29
2016–17	304	327	299	358	156	140	51	51	13	24
2017–18	208	230	267	247	139	93	38	34	4	16
2018–19	236	230	295	247	105	93	32	34	4	16
2019–20	199	230	289	247	96	93	29	34	4	16
2020–21	183	230	232	247	71	93	34	34	7	16
2021–22	148	230	186	247	104	93	32	34	5	16

Fish stock	BNS 10			
FMA (s)	10		Total	
	Landings	TACC	Landings	TACC
1981*	0	–	295	–
1982*	0	–	484	–
1983†	0	–	701	–
1984†	0	–	1 386	–
1985†	0	–	1 277	–
1986†	0	–	1 536	–
1986–87	7	10	1 411	1 350
1987–88	10	10	1 274	1 449
1988–89	10	10	1 420	1 566
1989–90	0	10	1 541	1 765
1990–91	#12	#10	1 781	1 831
1991–92	#40	#10	2 031	1 837
1992–93	#29	#10	2 335	2 016
1993–94	#3	#10	2 323	2 023
1994–95	0	10	2 285	2 161
1995–96	0	10	2 351	2 161
1996–97	#9	#10	2 846	2 480
1997–98	#30	#10	2 613	2 480
1998–99	#2	#10	2 775	2 480
1999–00	#0	#10	2 731	2 480

Table 2 [Continued]:

Fish stock	BNS 10			
FMA (s)	10		Total	
	Landings	TACC	Landings	TACC
2000–01	#0	#10	2 721	2 480
2001–02	#0	#10	2 784	3 048
2002–03	0	10	3 002	3 058
2003–04	0	10	3 091	3 058
2004–05	0	10	3 012	3 233
2005–06	0	10	2 475	3 233
2006–07	0	10	2 425	3 233
2007–08	0	10	2 498	3 233
2008–09	0	10	2 046	2 335
2009–10	0	10	2 059	2 335
2010–11	0	10	1 696	2 335
2011–12	0	10	1 218	1 590
2012–13	0	10	1 142	1 110
2013–14	0	10	1 153	1 110
2014–15	0	10	1 104	1 110
2015–16	0	10	960	1 110
2016–17	0	10	823	910
2017–18	0	10	656	630
2018–19	0	10	671	630
2019–20	0	10	616	630
2020–21	0	10	528	630
2021–22	0	10	475	630

* MAF data.
† FSU data.
# Includes exploratory catches in excess of the TAC.
+ An additional transitional 250 t of ACE was provided to Chatham Islands fishers, resulting in an effective commercial catch limit of 1175 t in 2001–02 and 2002–03.

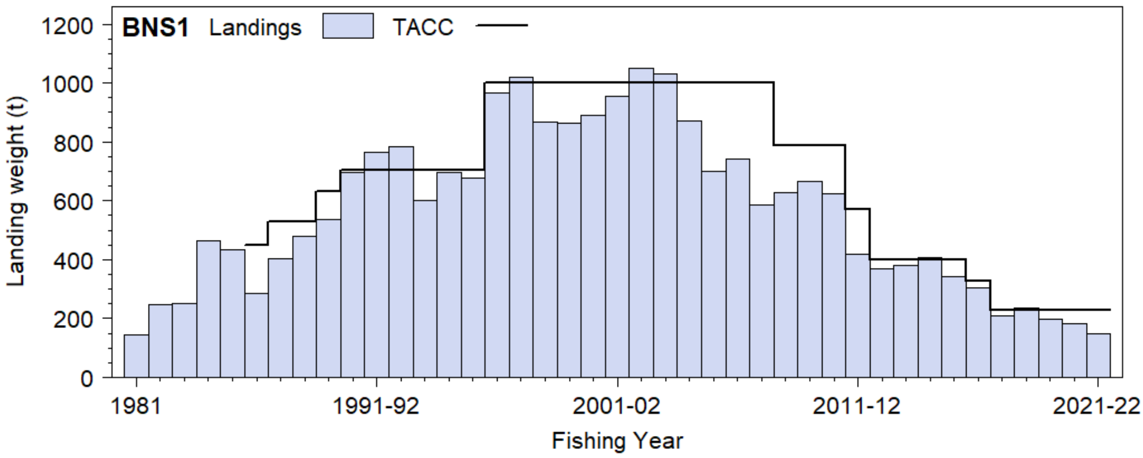
Bluenose landings prior to 1981 were poorly reported, with bluenose sometimes being recorded as bonita, or mixed with hāpuku/bass/groper, and foreign licensed and charter catches in the 1970s included bluenose catches as warehou and butterfish. Landings before 1986–87 have been grouped by statistical areas which approximate the current QMAs.

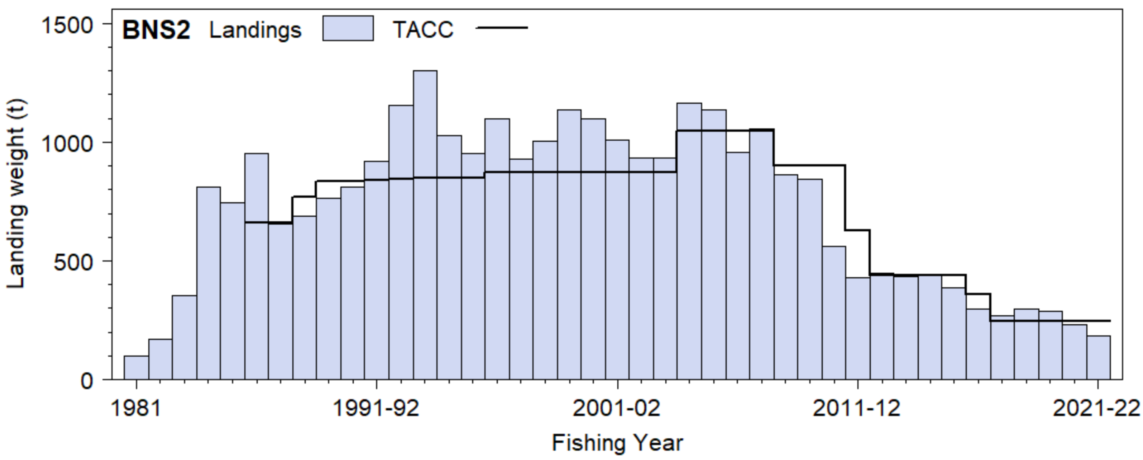
TACCs were first established for bluenose upon introduction to the QMS in 1986–87, with TACCs for all bluenose stocks totalling 1350 t. From 1992 to 2009 all bluenose fishstocks were included, for at least some of the time, in Adaptive Management Programmes (AMPs). BNS 3 was the first stock to enter an AMP in October 1992, with a TACC increase from 175 t to 350 t. This was further increased within the AMP to 925 t in October 2001, plus an additional transitional 250 t of ACE provided to Chatham Islands fishers in 2001–02 and 2002–03 only. BNS 7 (TACC increase from 97 t to 150 t) and BNS 8 (TACC increase from 22 t to 100 t) entered AMPs in October 1994. BNS 1, the second largest bluenose fishery, entered an AMP in October 1996, with a TACC increase from 705 t to 1000 t. BNS 2, the largest bluenose fishery, was the most recent entry into an AMP in October 2004, with a TACC increase from 873 t to 1048 t. TACCs for all bluenose stocks were reduced on 1 October 2008: 786 t (BNS 1), 902 t (BNS 2), 505 t (BNS 3), 89 t (BNS 7), and 43 t (BNS 8). AMP programmes were terminated on 30 September 2009.

Under a rebuild plan following the 2011 stock assessment, there have been further phased reductions to TACCs for bluenose stocks. On 1 October 2011, TACCs were reduced to: 571 t (BNS 1), 629 t (BNS 2), and 248 t (BNS 3); BNS 7 and BNS 8 were not reduced at that time. On 1 October 2012, TACCs were further reduced for all bluenose stocks to: 400 t (BNS 1), 438 t (BNS 2), 171 t (BNS 3), 62 t (BNS 7), and 29 t (BNS 8). The 2011 rebuild plan included a third phase of TACC reductions. For the 2016–17 fishing year, the Minister reduced the combined TACCs for bluenose stocks by 205 t as a further step towards ensuring the rebuild. He did not take stronger action because he wanted to provide the opportunity for a management procedure to be developed. As from October 2017, following the assessment being updated to include information up to the end of the 2015–16 year, the Minister noted that the stocks remained in a depleted state and he did not want to delay the rebuild any longer. Consequently, he reduced the TACCs for all BNS stocks further to ensure that BNS stocks rebuild towards the target at an appropriate rate consistent with the HSS guidelines.

As a result of the TACC increases under AMPs, the combined total TACC for all bluenose stocks increased from an initial 1350 t in 1986–87 to 3233 t by 2004–05. Reductions followed with the total

TACC set to 1110 t by 2012–13, to 910 t in 2016–17, and finally to 630 t in 2017–18. Catch performance against the TACC has varied, with the combined TACC being under-caught by an average 9% (average landings 1504 t a year) over 1987–88 to 1990–91, over-caught by an average 11% (average landings 2501 t a year) over 1991–92 to 2000–01, and under-caught by an average 19% (average landings 2180 t a year) from 2004–05 to 2011–12. More recently landings have fluctuated around the combined TACC, over-caught by an average of just 1% during 2012–13 to 2018–19.





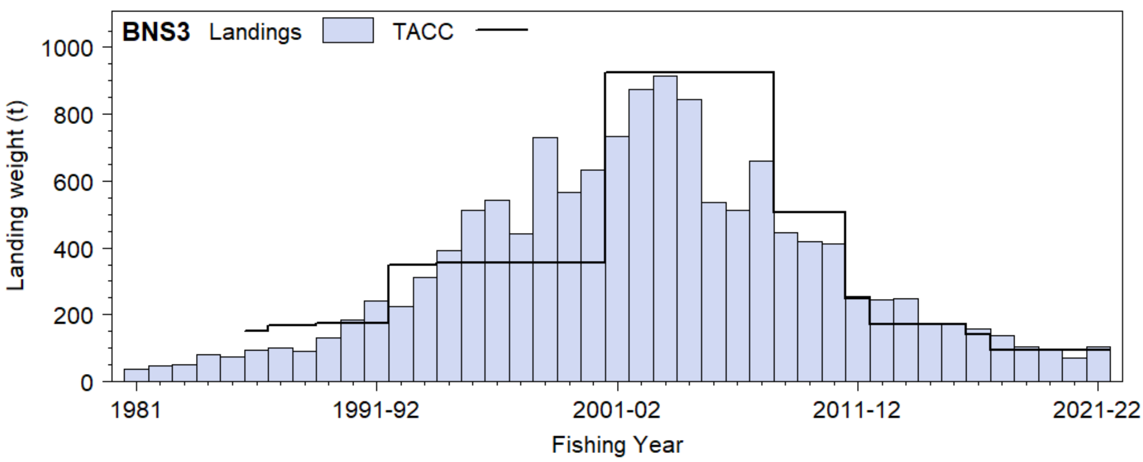
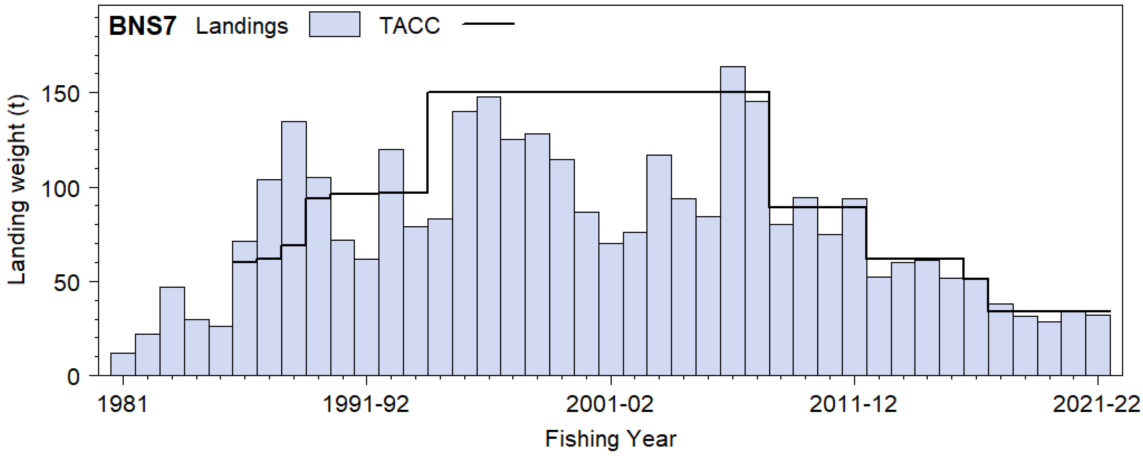


Figure 1: Reported commercial landings and TACC for the five main BNS stocks. BNS 1 (Auckland East), BNS 2 (Central East), BNS 3 (South East Coast). [Continued on next page]



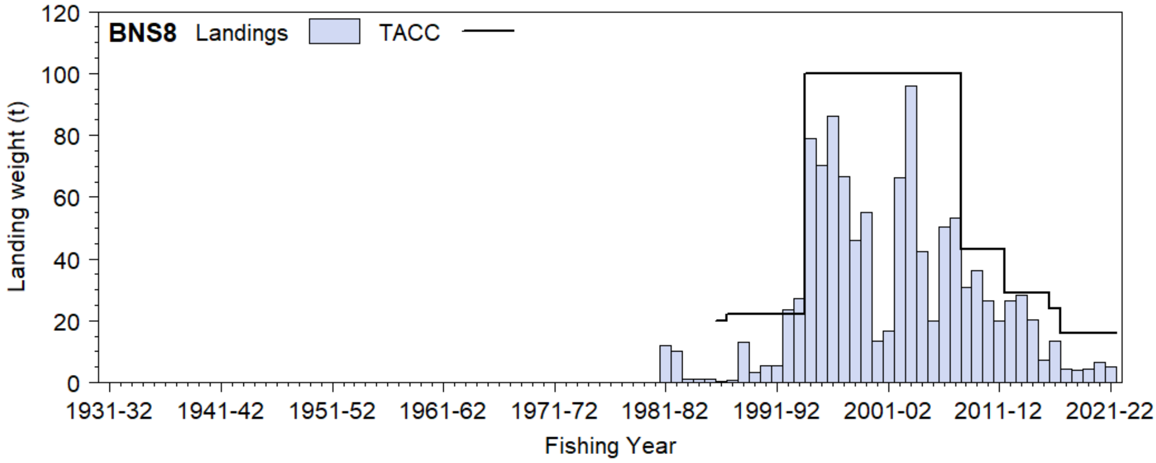


Figure 1 [Continued]: Reported commercial landings and TACC for the five main BNS stocks. BNS 7 (Challenger), BNS 8 (Central Egmont).

1.2 Recreational fisheries

Bluenose is targeted by recreational fishers around deep offshore reefs. They are caught using line fishing methods, predominantly on rod and reel with some longline catch. The allowances within the TAC for each Fishstock are given in Table 1.

1.2.1 Management controls

From 2012 onwards the catch limit for recreational fishers in all areas has been up to 5 bluenose per person per day as part of their multi-species (combined) individual daily bag limit.

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 bluenose were calculated using an offsite approach, the offsite regional telephone and diary surveys. Estimates for 1996 came from a national telephone and diary survey (Bradford 1998). Another national telephone and diary survey was carried out in 2000 (Boyd & Reilly 2002) and a rolling replacement of diarists in 2001 (Boyd et al 2004) allowed estimates for a further year (population scaling ratios and mean weights were not re-estimated in 2001). The annual recreational catch of BNS 1 was estimated from diary surveys to be 2000 fish in 1993–94 (Teirney et al 1997), 5000 fish in 1996 (Bradford 1998), and 11 000 fish in 1999–00 (Boyd et al 2004). The harvest estimates provided by these telephone/diary surveys are no longer considered reliable.

A new national panel survey was developed and was implemented in 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 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 3. Note that national panel survey estimates do not include recreational harvest taken under s111 general approvals.

Table 3: Recreational harvest estimates for bluenose stocks (Wynne-Jones et al 2014, 2019). Mean fish weights were obtained from boat ramp surveys; for bluenose the value used was 4.473 kg (Hartill & Davey 2015).

Stock	Year	Method	Number of fish	Total weight (t)	CV
BNS 1	2011–12	Panel survey	6 287	28.15	0.40
	2017–18	Panel survey	7 571	36.45	0.29
BNS 2	2011–12	Panel survey	444	1.99	0.48
	2017–18	Panel survey	1 298	6.12	0.43
BNS 3	2011–12	Panel survey	461	2.05	0.92
	2017–18	Panel survey	405	1.91	0.60
BNS 7	2011–12	Panel survey	456	2.02	1.00
	2017–18	Panel survey	355	1.67	0.60
BNS 8	2011–12	Panel survey	137	0.61	1.03
	2017–18	Panel survey	0	0	–

The recreational surveys indicate that the recreational harvest of bluenose is relatively small in areas other than BNS 1. There are some locally important fisheries which will not have been adequately sampled by the national panel survey.

1.3 Customary non-commercial fishing
No quantitative information on the level of customary non-commercial take is available.

1.4 Illegal catch
No quantitative information on the level of illegal catch is available.

1.5 Other sources of mortality
There have been reports of depredation by orca on bluenose caught by line fisheries.

2. BIOLOGY

Depth distribution
The depth distribution of bluenose extends from near-surface waters to about 1200 m. Research trawl surveys record their main depth range as 250–750 m, with a peak at 300–400 m, and they regularly occur to about 800 m (Anderson et al 1998). Commercial catches recorded in logbook programmes implemented for some of the bluenose stocks under AMPs, and catch-effort data for these fisheries, confirm that bluenose catches range in depth from less than 100 m to about 1000 m, depending on target species, but with a peak around 400 m for bluenose targeted fishing by any method.

The depth distribution of bluenose changes with size, with small juveniles known to occur at the surface under floating objects (Last et al 1993, Duffy et al 2000). Larger juveniles probably live in coastal and oceanic pelagic waters for one or two years. Fish 40–70 cm in length are caught between 200 m and 600 m, whereas larger fish, particularly those larger than 80 cm, are more often caught deeper than 600 m. A sequential move to deeper waters as bluenose grow has been confirmed by analysis of the stable radio-isotope ratios in otolith sections. Oxygen isotope ($\delta^{18}O$) ratios of bluenose otolith cores confirm residence of juvenile fish within surface waters. Changes in oxygen isotope ratios across otolith sections indicate changes in preferred mean depth with age of each fish (Horn et al 2008). That study hypothesised that the larger adults may be distributed below usually fished depths on underwater topographic features, but potentially available to fisheries as a result of regular vertical feeding migrations. The largest adults appear to reside in 700–1000 m; i.e., deeper than where most trawl or longline fishing for bluenose occurs. However, adult bluenose are also known to associate closely with underwater topographic features (hills and seamounts). Bluenose may undertake diurnal migrations into shallower depths to feed.

Age, growth, and natural mortality

Biological parameters for bluenose are summarised in Table 4. Recent ageing validation work by Horn et al (2008, 2010) substantially revised estimates of maximum age- and size-at-maturity for bluenose which were previously considered to be moderately fast growing (Horn 1988b). Radiocarbon (^{14}C) levels in core micro-samples from otoliths that had been aged using zone counts were compared with a bomb-radiocarbon reference curve which provided independent estimates of the age of the fish.

Table 4: Estimates of biological parameters for bluenose. Growth parameters from Dunn et al (2021) were used in the stock assessment, but only for ages five and older; growth for younger fish was assumed to be linear between the length at age five and t = -0.5.

Fishstock						Estimate	Source
1. Natural mortality (*M*)							
BNS						0.07–0.14	Horn & Sutton (2011)
2. Weight = a(length)^b (Weight in g, length in cm fork length).							
						Both sexes	
BNS 2				a = 0.00963		b = 3.173	Horn (1988a)
3. Von Bertalanffy growth parameters							
			Females			Males	
	K	t_0	L_∞	K	t_0	L_∞	
BNS 2	0.071	-0.5	92.5	0.125	-0.5	72.2	Horn et al (2010)
BNS 2	0.019	-20.9	120.4	0.046	-15.0	79.4	Dunn et al (2021)
3. Age at maturity (50%)							
			Females			Males	
a_{50} (a_{to95})			17 (11)			15 (6)	Horn & Sutton (2011)

Horn & Sutton (2010) estimated a maximum age of 71 years for bluenose from line fisheries in BNS 1. This maximum age is consistent with the maximum age of 85 years estimated for the closely related barrelfish (*Hyperoglyphe perciformis*) in the western North Atlantic, also determined, in part, using the bomb chronometer method (Filer & Sedberry 2008). Previous under-estimates of bluenose ages appear to have resulted from the incorrect interpretation of paired, fine ‘split rings’ as single growth zones, when they probably represent two separate growth zones. Horn & Sutton (2010) concluded *M* for bluenose would likely be in the range 0.09–0.15, based on 1% of the unfished population living to 30–50 years. However, they also noted that the true *M* for bluenose could be even lower than 0.09 given that the maximum recorded age was 71 years, and that old bluenose may be poorly sampled by the line fishery.

Horn & Sutton (2011) recorded a maximum age of 76 years for bluenose from trawl fisheries in BNS 2 and estimated total mortality (*Z*) to be in the range 0.11–0.26. Because bluenose had been only lightly exploited before the samples were taken (1984–86), these estimates of *Z* could be considered as reasonable proxies for natural mortality (*M*) because *F* would be very small. However, the *Z* estimates at the high end of the range are clearly inappropriate as *M* values for a species with a maximum age in excess of 50 years. Because of problems in obtaining a representative age sample of the population, Horn & Sutton (2011) favoured *M* estimation methods based simply on observed longevity. They concluded that a plausible range for *M* would be 0.07 to 0.14, with 0.10 as the best point estimate.

Previous stock assessments assumed an *M* of 0.08 as the best point estimate. From the range of estimates resulting from ageing, the working group concluded that *M* for bluenose was unlikely to be greater than 0.1. The *M* assumed in historical stock assessments was consequently 0.06, 0.08, or 0.1.

Maturity and reproduction

Little is known about the reproductive biology of bluenose. Maturity ogives derived from aged bluenose caught in BNS 1 from January to May indicated that ages at 50% maturity were about 15 and 17 years for males and females, respectively (Horn & Sutton 2011). Data from commercial logbook programmes implemented under AMPs indicate that bluenose sampled in QMAs 1, 3, 7, and 8 matured at between 60 cm and 65 cm. Analysis of gonad maturity stage proportions for bluenose sampled by Fisheries New Zealand observers and commercial logbook programmes, primarily in BNS 1, 7, and 8, indicate that spawning takes place over an extended period but peaks from February to April annually. No distinct spawning grounds have been described for bluenose in New Zealand waters. Most reproductively active fish have been sampled from locations in the Bay of Plenty, and in smaller numbers from several locations around the North Island, from northwest of Taranaki to East Cape, and off the south west coast of the South Island (Dutilloy et al 2020).

3. STOCKS AND AREAS

Stock boundaries are unknown, but similarity in trends in catch and CPUE across fisheries occurring in each of the five New Zealand BNS QMAs suggests the possibility that there may be a single BNS stock across all these areas, or of some close relationship between stocks in these QMAs. Tagging studies have shown that bluenose are capable of extensive migration, i.e., from the Wairarapa coast to Kāikoura, Bay of Plenty, and North Cape (Horn 2003). There is a possibility that the long period of relatively stable CPUE observations in the face of increasing catches before the period of decline may be evidence of hyper-stability caused by the replenishment of adult stocks on specific areas or features. Increases in BNS targeting in some areas, and increasing catches, could have exceeded the replenishment rate and caused the rapid and largely synchronous declines observed from about 2001–02 to 2011–12. Alternatively, there could be a simultaneous drop in recruitment due to coincident environmental factors. An environmental mechanism simultaneously affecting availability or catchability of BNS across all QMAs is considered to be less likely than the possibility of a single stock, or of correlated recruitment across sub-stocks in the various areas.

Analyses of length samples from research surveys and commercial catches indicated the smallest bluenose (predominantly juveniles) had been caught in relatively shallow water (shallower than 445 m) off the east coast of central and northern New Zealand, from Chatham Rise to East Northland, and the largest bluenose were caught off the south of the South Island and in the more northern parts of BNS 1 and in BNS 10 (Dutilloy et al 2020). Bottom longlines caught both the largest, and smallest, fish observed. Particle tracking studies, assuming that juvenile bluenose drift passively in ocean surface currents for the first year of life, suggested juveniles from spawning locations on both coasts of the North Island would accumulate on the east coast of central and northern New Zealand (Dutilloy et al 2020). Particles released off the west and south coasts of the South Island were predominantly retained in that area. Genetic analyses for the allied species hāpuku (*Polyprion oxygeneios*) found differences between fish from waters west of the South Island, and those from around the North Island and east of the South Island (Lane et al 2016). CPUE models were offered alternative spatial areas (to explain variability in bottom longline catch rates) and accepted the nine relatively fine-scale areas identified by Bentley (Bentley unpublished), but rejected other splits including separation of the west and south coast of the South Island from the rest of New Zealand (Dutilloy et al 2020). A single stock of bluenose around New Zealand remains most likely, although division into two stocks, separating the west and south coast of the South Island from the rest of New Zealand, remains possible.

4. STOCK ASSESSMENT

The most recent stock assessment modelling for bluenose was conducted in 2021. The model was implemented in the general-purpose Bayesian stock assessment program Casal2 V1.0.0 (CASAL2 Development Team 2021), with functionality added to allow fitting of weight composition data.

4.1 Methods

Model structure

The age-based model assumed a single New Zealand stock of bluenose, partitioned into two sexes, with 61 age groups (1–61 years with a plus group), and without maturity in the partition. The model had a single time step, four year-round fisheries (three line and one trawl), and mid-fishing-year spawning. The stock was assumed to be at B_0 in 1915. All fishery and biological parameters were assumed to be constant. Recruitment was assumed to be deterministic with the Beverton and Holt stock recruit relationship.

The base model included two areas in the partition, a 'background' area where recruitment and the trawl fishery took place, and a 'features' area where the bluenose target line fisheries took place (Table 5). Fish were assumed to move from the background to the features at a constant rate-at-age (same rate for each age), which was estimated by the model. The rate parameter controls with partitioning of biomass between the two areas and, with catches partitioned by area, allows the biomass to potentially decline at different rates within each area.

Table 5: Bluenose 2021 stock assessment assumed fisheries, model area, total catch (1936–2021; assuming 'Mid' catches before 1990, see Table 6), selectivities, what composition data were used (LF, length frequency; AF, age frequency; WF, weight frequency), and whether CPUE indices were available. * Selectivity for East Northland, and Bay of Plenty and East Cape, were estimated to be similar and set to be the same in all final model runs.

Fishery	Area	Total catch (t)	Selectivity	Composition data	CPUE indices
Trawl	Background	22 870	Logistic	AF, and Observer LF	Yes
East Northland longline	Features	12 780	Double normal*	WF	Yes
Bay of Plenty & East Cape longline	Features	14 390	Double normal*	AF and WF	Yes
Wairarapa longline	Features	7 470	Double normal	WF	Yes
Other longline	Background	19 630	Logistic	WF	No

Data

The catch history in the model starts in 1936 when some bluenose were landed as groper or hāpuku. The main uncertainty in the catch history is the foreign catch just prior to the implementation of the EEZ in 1978. Foreign vessels recorded bluenose catch within mixed species groups, typically as part of a general warehou category. Catch data in the early 1980s were used to estimate the likely proportion of bluenose within a mixed warehou and bluenose group. Where possible, this was done on an area-specific basis and the proportions were applied to the pre-EEZ mixed species catches. Due to the uncertainties in species attributions mentioned above, alternative bluenose proportions were used to construct three alternative catch histories: low, mid (the base assumption), and high (Table 6).

The catch histories for the line and trawl fisheries from 1989–90 to 2006–07 were derived from the bluenose characterisations conducted for the 2008 AMP review. From 2007–08 onwards, the total recorded catch was split between line and trawl fisheries in roughly the same proportion as the catches from the 2006–07 year. The 2020–21 catch was assumed to be the same as that in 2019–20. Recreational and illegal catch were assumed to be zero.

Twelve standardised CPUE indices were fitted as indices of abundance. These were a single trawl bycatch index for 1989–90 to 2019–20 (bycatch in alfonsino, bluenose, and hoki target fishing), and eleven bottom longline bluenose target indices, which covered consistently fished features off (a) east Northland, (b) Bay of Plenty and East Cape, and (c) Wairarapa. The bottom longline indices were estimated for 1995–2002, 2003–2007, 2008–2012, and 2013–19. The index for Wairarapa for 1995–2002 was excluded because of insufficient data. Data prior to 1995 were excluded because of a potential bias in CPUE caused by the introduction of GPS in the early 1990s, and 2020 was excluded because concerns about potential biases following the widespread introduction of electronic reporting (which the WG considers can be resolved). The split between 2002 and 2003 was introduced because of the introduction of 3-D mapping around 2002, which was believed to have increased catch rates. The split between 2007 and 2008 was introduced because of a change in catch reporting forms. The split between 2012 and 2013 was introduced because the TACC reduction was believed to have modified fisher behaviour. An additional CV of 10–20% was added to the estimated lognormal error CVs for the CPUE indices, because they were considered unrealistically low (as is typical for indices estimated using a GLM approach). A CPUE series based on BNS catches in the HPB (hāpuka/bass) target longline fishery, was generated but not fitted. This series is assumed to index relative abundance of the background area and showed a similar trend to the trawl series. An alternative trawl index, estimated from alfonsino and bluenose target fishing only, was also used as a sensitivity.

Table 6: The three alternative catch (t) histories used in the BNS assessment model runs. Trawl catch prior to 1970 was assumed to be zero. Year represents fishing year (i.e., 2020 is the 2019–20 fishing year).

	Line				Line				Trawl		
Year	Low	Mid	High	Year	Low	Mid	High	Year	Low	Mid	High
1936	0	75	150	1963	0	59	119				
1937	0	75	150	1964	0	66	133				
1938	0	75	150	1965	0	64	128				
1939	0	75	150	1966	0	61	123				
1940	0	56	112	1967	0	65	129				
1941	0	50	100	1968	0	57	113				
1942	0	50	100	1969	0	55	111				
1943	0	50	100	1970	0	70	140	1970	0	0	0
1944	0	50	100	1971	0	69	138	1971	0	0	0
1945	0	50	100	1972	0	59	118	1972	0	45	78
1946	0	69	138	1973	0	63	126	1973	0	42	72
1947	0	75	150	1974	0	69	137	1974	0	68	117
1948	0	81	162	1975	111	182	252	1975	0	116	204
1949	0	95	189	1976	618	692	767	1976	0	112	211
1950	0	89	177	1977	821	913	1 004	1977	0	385	1 505
1951	0	74	147	1978	1	81	161	1978	0	0	0
1952	0	71	142	1979	9	92	176	1979	0	0	0
1953	0	70	141	1980	15	98	180	1980	0	0	0
1954	0	69	137	1981	235	300	365	1981	0	0	0
1955	0	66	132	1982	469	511	554	1982	0	0	0
1956	0	69	138	1983	730	755	780	1983	0	0	0
1957	0	69	138	1984	951	956	962	1984	324	324	324
1958	0	75	149	1985	1 013	1 013	1 013	1985	372	372	372
1959	0	68	137	1986	982	982	982	1986	605	605	605
1960	0	62	124	1987	744	744	744	1987	667	667	667
1961	0	60	121	1988	752	752	752	1988	522	522	522
1962	0	59	118	1989	797	797	797	1989	623	623	623

For all three catch histories

Year	Trawl	Line	Year	Trawl	Line
1990	730	808	2006	679	1 796
1991	572	1 204	2007	379	1 995
1992	559	1 472	2008	374	2 124
1993	721	1 590	2009	301	1 745
1994	870	1 450	2010	418	1 641
1995	841	1 443	2011	379	1 317
1996	793	1 558	2012	213	1 005
1997	1 061	1 690	2013	146	995
1998	814	1 732	2014	174	979
1999	860	1 867	2015	171	933
2000	983	1 693	2016	165	796
2001	1 118	1 589	2017	122	701
2002	1 393	1 374	2018	117	539
2003	1 294	1 642	2019	135	537
2004	934	2 157	2020	123	493
2005	1 069	1 943			

Observer length samples were used to construct annual length frequencies for the trawl fisheries for each year when there were more than 1000 fish measured (1997–98 to 1999–2000). For each sample, the length frequency was scaled to the numbers of fish in the sampled catch. Catch-weighted samples were then combined with no further scaling or stratification.

Fifteen age frequencies were fitted: three from trawl caught fish on the Palliser Bank, for the fishing years 1984–85, 1985–86, and 1986–87; and twelve for line caught fish in the Bay of Plenty and East Northland, for the fishing years 1996–97 to 2000–01, 2004–05 to 2006–07, and 2013–14 to 2016–17. Age samples were assumed to be random and scaled by catch. The age frequencies were the most direct estimates of selectivity-at-age and consequently were given higher effective sample sizes than the length and weight frequencies.

Weight compositions for bottom longline fisheries were also available from three Licensed Fish Receivers, derived from data on the number and total weight of bluenose in each pack sold. Data covered the same areas as assumed for CPUE analyses: east Northland (1997–98, 1998–99, and 2000–01 to 2019–20); Bay of Plenty and East Cape (2000–01 to 2002–03, 2004–05 to 2019–20); Wairarapa (2006–07, 2007–08, and 2012–13 to 2015–16); and also the west coast South Island (2015–16 to 2017–18; used to inform selectivity for all longline catches other than off the east coast North Island). The weight compositions were derived from mean weight data, which resulted in a spiky and variable appearance. Simulation exercises indicated that spikes were expected as a result of the way the pack data were collected. Although Casal2 was extended to account for the averaging of weights, the true statistics of the sample compositions were not known (such as the range of fish lengths that could occur in each pack), and these data could only be roughly fitted by the model.

All composition data were fitted assuming multinomial errors, with effective sample sizes scaled in accordance with observed sample sizes, then reduced to give primacy to fitting the CPUE indices. The length, age, and weight composition observations were often inconsistent from year-to-year and vary substantially on small spatial and temporal scales. Therefore, when evaluating model fits, the most importance was given to broadly capturing the shape of the frequency distributions, so that the age composition of catch removals would be approximately correct. The available composition data are inadequate to allow reasonable estimation of variation in year class strengths.

Fixed and estimated parameters

The estimated parameters were B_0 (uniform-log prior), logistic selectivity for the trawl fishery (two parameters), logistic selectivity for the east Northland, and Bay of Plenty and East Cape, CPUE and fisheries (two parameters), domed-selectivity for the Wairarapa CPUE and fishery (three parameters), logistic selectivity for other longline fisheries (two parameters), and the migration rate from background to features (one parameter). Priors on all parameters other than B_0 were uniform. Catchabilities (qs), for fitting the CPUE indices, were estimated as nuisance parameters.

The fixed parameters were year class strengths (i.e., recruitment was deterministic), growth, logistic maturation, stock-recruitment steepness (h), and natural mortality rate (M). The reference model assumed $M = 0.08$ yr^{-1} and $h = 0.84$.

Growth used empirical data of length at age rather than using the von Bertalanffy parameters (Table 4), because the latter did not adequately fit the observed pattern of length-at-age. The variability of length at age was assumed normal with CV = 7%, and variability of weight-at-length normal with CV = 10%. A normal ageing error with CV = 10% was assumed.

Model parameters were initially estimated as MPD, with MCMC used for final model runs.

Assessment runs

The working group agreed to present results from four final model runs; (1) a base model run, (2) a run assuming lower steepness (0.6), (3) a run excluding the weight composition data, and (4) a model run assuming a single area rather than two areas.

When the weight composition data were excluded, the selectivities were estimated from age and observer length frequency data only, and the Wairarapa longline fishery was set equal to that estimated for the Bay of Plenty and East Cape fishery, and the other longline selectivity set equal to the trawl fishery (the selectivity a_{50} for the Other Longline fishery being closer to the Trawl than Bay of Plenty & East Cape estimates in the two-area model).

The sensitivity model run assuming a single area used the same data, data weighting, and assumptions as the two-area base model run, except that the trawl fishery and CPUE had a double normal selectivity, and the Wairarapa longline fishery and CPUE had a logistic selectivity.

4.2 Results

The decline in standardised CPUE for the Bay of Plenty and East Cape, and east Northland, fisheries was almost twice that seen in the trawl fishery (Figure 2). Not all trends in the CPUE series were fitted well by the model. The best fit was to the east Northland indices, and the poorest to the Bay of Plenty and East Cape indices. The decline in Wairarapa CPUE, and Bay of Plenty and East Cape CPUE, between 2003 and 2007 was greater than could be explained by the catches. Fits to the CPUE series were constrained by the assumption of deterministic recruitment. The CPUE indices for the longline fisheries all indicated a biomass increase over the last three years, whereas a decline was seen in the trawl fishery.

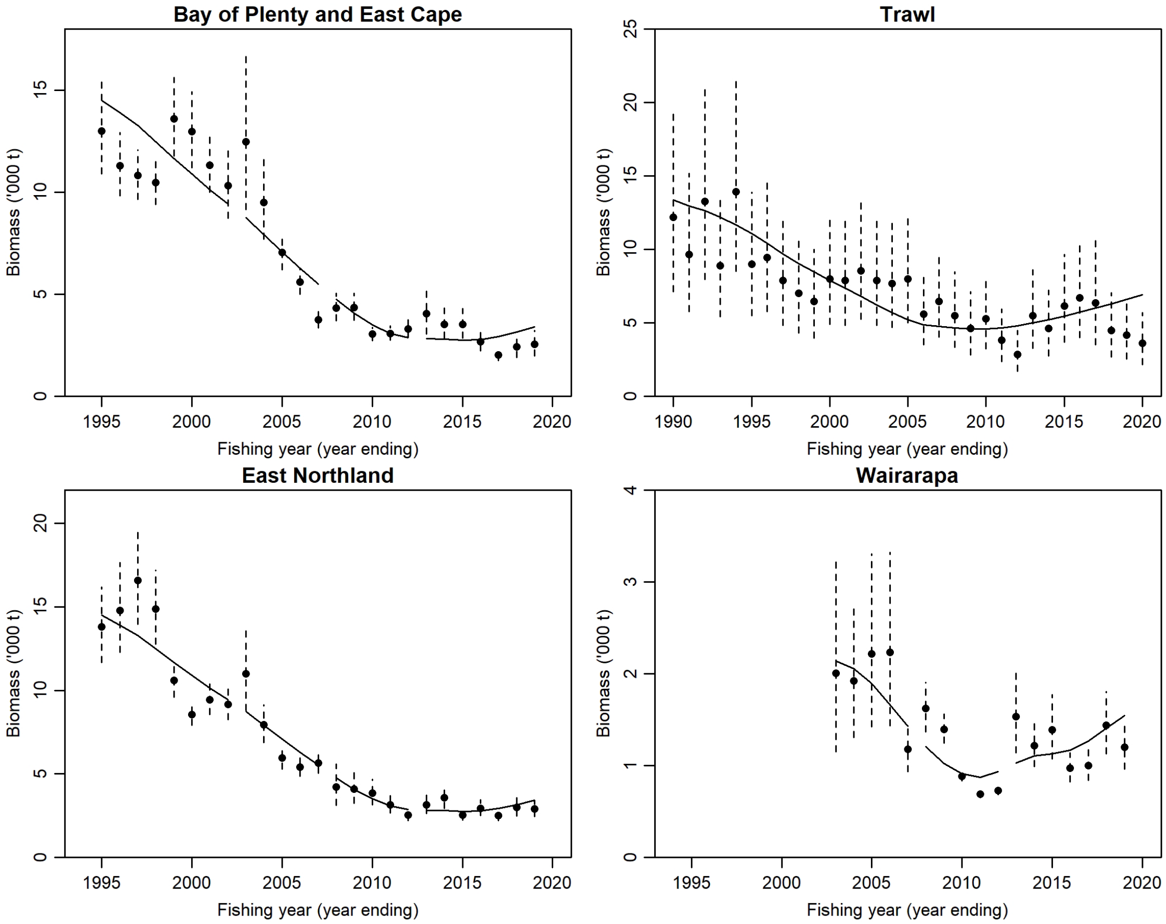


Figure 2: Bluenose CPUE indices (points, vertical broken lines indicate 95% CI) and base model run MPD fits (lines).

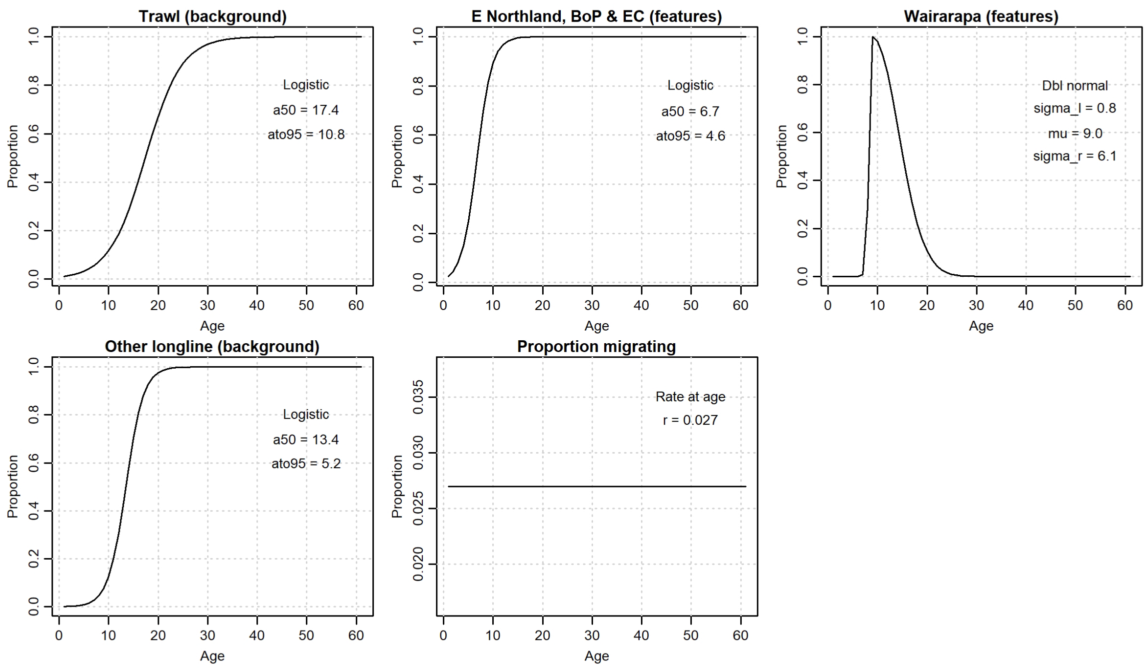


Figure 3: Bluenose estimated fishing selectivities and migration rate for the trawl and longline fisheries for the base model MPD run.

The youngest bluenose were taken by the Wairarapa longline fishery, then East Northland and Bay of Plenty and East Cape longline fisheries, then other longline fisheries (predominantly BNS 7 and BNS 3), and then the trawl fishery (Figure 3).

The model estimated age compositions for the catches that fitted the observations about as well as could be expected given the inconsistent shape of the age frequencies in the consecutive years (Figure 4). The base model run generally over-estimated the proportion of old fish in the plus group. The fits to the weight composition data were similarly variable, and those to the length frequencies were good.

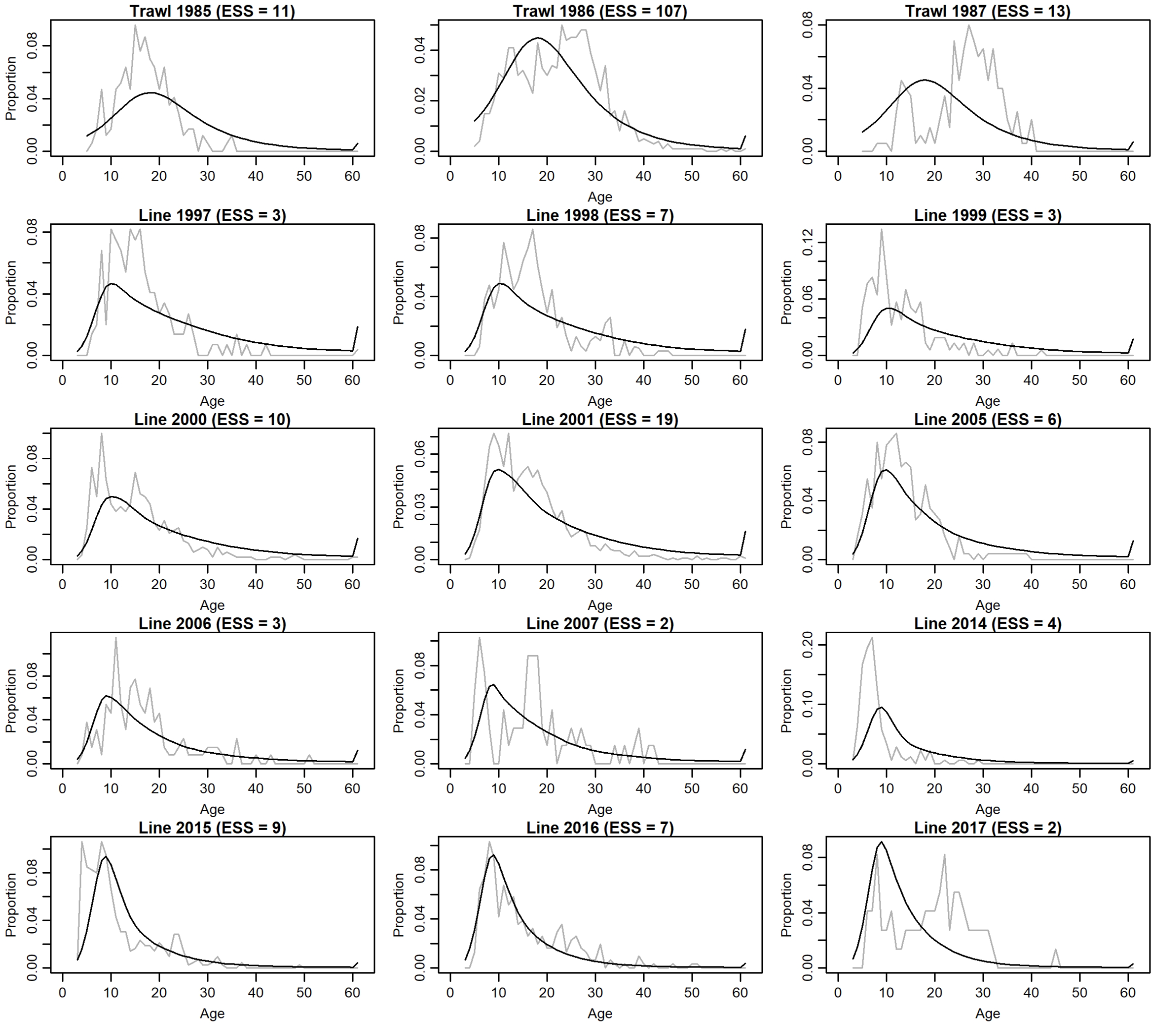


Figure 4: Bluenose observed age frequency samples (grey lines) and base model MPD fits (black lines) for the base model run. The model fit is focused on samples with higher effective sample sizes; effective sample sizes (ESS) are given in parentheses.

Sensitivity runs

A wide range of model sensitivity runs were completed. The assessment was particularly sensitive to natural mortality rate and stock-recruitment steepness. When a higher M was assumed (0.1 yr^{-1}) the stock was estimated to be smaller and less depleted and the fit to the composition data was improved (the proportion in plus group noticeably reduced), but the fit to the recent CPUE indices worsened. The reverse was obtained when a lower M (0.06 yr^{-1}) was assumed. When steepness was lower than the base case, the rate of the biomass rebuild was reduced, and the fit to the most recent CPUE indices improved, but the fit to the composition data worsened. The assessment model was less sensitive to changes in the shape of the selectivity ogives, alternative trawl CPUE indices, alternative catch histories, and whether the weight composition data were included.

When a single area was assumed, the spawning stock was estimated to have a similar B_0 but to be less depleted. This is most likely because the selectivity for the 'features' fishery was shifted towards older fish, primarily to reduce the vulnerable biomass to better fit the longline CPUE indices, but in doing so also reducing the vulnerable proportion of the *SSB*.

Final model runs

For the base model, and the selected sensitivity runs, MCMC diagnostics were acceptable. Although the stock size and status were relatively well determined (Table 7), some of the selectivity parameters had wide CI, most likely because of the inconsistencies in the composition data being fitted. Including the weight composition data reduced the uncertainty in longline selectivity parameters.

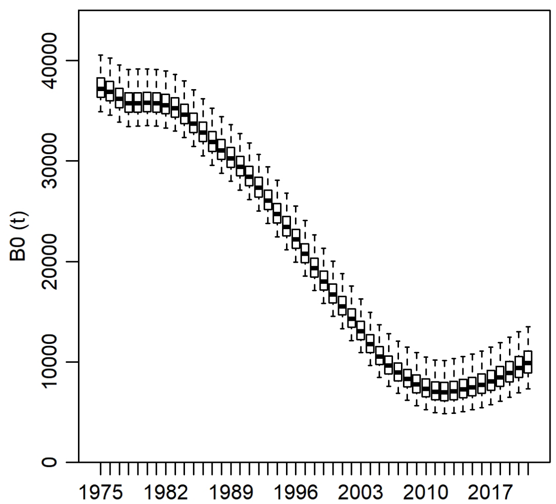
All model runs were indicative of a B_0 around 39 000 t, and current stock status close to, or just above, the soft limit and rebuilding. The base, excluding weight composition, and one area model runs, indicated a persistent *SSB* decline followed by a rebuild starting in 2012–13 (Figure 5). The lower steepness run estimated a *SSB* rebuild starting in 2013–14. The rate and timing of the rebuild in vulnerable biomass varied with the area and selectivity of the fishery (see Figure 2).

For the base model, there was a 97% probability that the stock was above 20% B_0 in 2021. For the sensitivity runs, the probability of being above 20% B_0 in 2021 was between 62% (lower steepness), and 100% (one area). For all model runs, the probability of being above the hard limit was 100%.

Table 7: Bluenose, MCMC estimates of virgin biomass (B_0), and stock status (B_{2021} as % B_0), with 95% CI in parentheses, for the base model and three sensitivity runs. Probability of being above the assumed target (40% B_0), soft limit (20% B_0) and hard limit (10% B_0) estimated from MCMC.

Model run	B_0 (000 t)	B_{2021} (%B_0)	p(B_{2021}>40% B_0)	p(B_{2021}>20% B_0)	p(B_{2021}>10% B_0)
Base	39 100	25.3	0.00	0.97	1.00
	(36 780 – 42 400)	(19.8 – 32.0)			
Lower steepness (h = 0.6)	40 900	20.9	0.00	0.62	1.00
	(39 200 – 43 500)	(16.4 – 26.7)			
Exclude weight frequency data	39 000	25.6	0.01	0.96	1.00
	(36 500 – 42 600)	(19.2 – 32.6)			
One area	38 600	31.6	0.04	1.00	1.00
	(35 400 – 44 300)	(24.4 – 41.1)			

For the base model run, the exploitation rate was estimated to be high enough to reduce the stock below the soft limit between 2002–03 and 2010–11, and then declined steadily, being close to the level associated with the biomass target since 2017–18 (Figure 6).



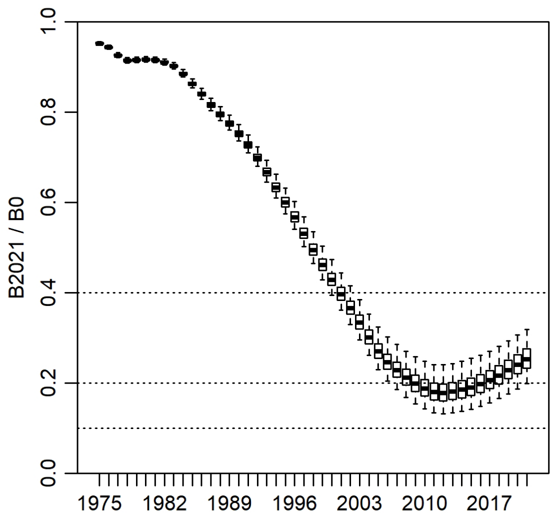


Figure 5: Bluenose Spawning Stock Biomass (*SSB*) trajectories and *SSB* as a proportion of B_0, for the base MCMC model run. Horizontal lines on the right panel indicate the assumed target (40% B_0), and soft (20% B_0), and hard (10% B_0) limit reference points. The box in each year covers 50% of the distribution and the whiskers extend to 95% of the distribution.

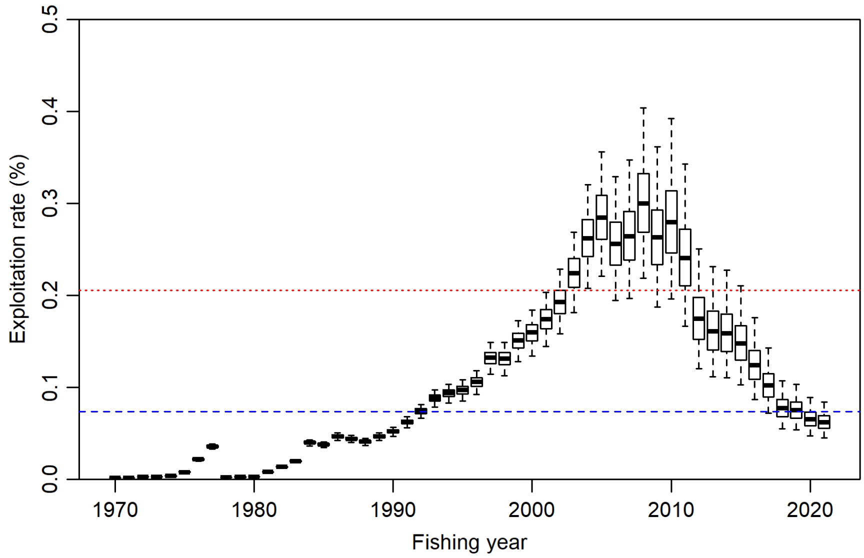


Figure 6: Bluenose MCMC estimated exploitation rate by fishing year for the base model run. The box in each year covers 50% of the distribution and the whiskers extend to 95% of the distribution. The exploitation rate associated with the soft limit of 20% B_0 is marked by the upper horizontal line, and that associated with the biomass target of 40% B_0 by the lower horizontal line.

4.3 Projections

Deterministic projections to 2041 using the base model run were carried out with constant future catches (2020–21 catch and TACC), maintaining the 2020–21 ratio between catches from the fisheries. The assumed constant future catches were: Northland and Bay of Plenty & East Cape longline, 287 t; Wairarapa longline, 79 t; Other longline, 126 t; Trawl, 124 t (total 616 t). The catches by fishery were prorated for projections with future constant catches at the TACC (630 t).

The stock was estimated to rebuild slowly and achieve a stock status of just above 30% B_0 within five years (Table 8). The rebuild would be very slightly slower if the future catches were at the current TACC rather than 2020–21 catch. The projected *SSB* achieved a 70% or greater probability of being at or above the target (40% B_0) in 2036–37 assuming the 2020–21 catch, or 2037–38 assuming the TACC.

Table 8: Bluenose, estimates from MCMC of the stock status (median and 95% CI) and probability of the *SSB* being greater than the target (40% B_0), assuming constant future catches at the level of either the 2020–21 catch, or 2020–21 TACC, using the base model run.

	2020–21 catch		2020–21 TACC	
Fishing year	SSB_{year}/B_0	p(SSB>40% B_0)	SSB_{year}/B_0	p(SSB>40% B_0)
2021–22	26.5 (19.8–35.9)	0.01	26.5 (19.8–35.9)	0.01
2022–23	27.7 (20.8–37.3)	0.01	27.7 (20.8–37.3)	0.01
2023–24	28.9 (21.8–38.7)	0.02	28.9 (21.8–38.7)	0.02
2024–25	30.1 (22.8–40.1)	0.03	30.1 (22.8–40.0)	0.03
2025–26	31.3 (23.8–41.4)	0.04	31.2 (23.7–41.3)	0.04

4.4 Other factors

This assessment relies on standardised catch per unit effort as an index of abundance. In 2016 members of the fishing industry noted that bluenose fisheries have undergone a number of changes, not all of which are adequately captured in the statutory catch and effort data. These include changes in quota holdings, company structures and vessel operators, and shifts in fishing practice. The longline fishery data have been researched in most detail, and the splits in the time series used for assessment were a response to some of these issues. A further nearly 50% reduction in TACC occurred between 2015–16 and 2017–18, and future CPUE analyses should examine whether this cut may have caused further changes to fishing practice.

The base model predicted the biomass was rebuilding, but the most recent three years of the trawl CPUE declined, as did the HPB longline index. The alternative trawl CPUE index increased in 2019–20. It is suspected that trawl fishers may be avoiding areas where bluenose bycatch is relatively high due to the unavailability of ACE, which may bias the trawl CPUE low as the stock rebuilds.

More complex spatial structuring of bluenose populations and fisheries is also plausible and may be the cause of inconsistencies in the data, and some poor fits of the model. The plus group predicted by the model, not apparent in the data, may be because older fish move permanently to deeper water and become unavailable to the fishery; the assessment model assumes they are fully available. A sensitivity run with domed selectivity for the 'features' fishery allowed older fish to be unavailable, but it did not materially improve the fit. Assuming domed selectivity across all fisheries would allow an unverified and unavailable proportion of the mature biomass to exist (a 'cryptic spawning stock biomass'). If the misfit to the plus group is because (a) age-based cryptic biomass does exist, or (b) M is higher than assumed, then the current assessment stock status should be biased low and is precautionary.

In addition to cryptic biomass through age selectivity, cryptic biomass might also occur spatially. The assessment assumes all fish within the 'features' area are available. But if fish do not mix sufficiently, then areas may exist outside the main fisheries where bluenose are resident, and infrequently or not fished. There is evidence from fishery characterisation that such areas likely exist following the TACC, and targeted fishing effort, reduction. The limited tagging data, and similarity of some spatial CPUE trends, are supportive of mixing. However, if a spatial cryptic biomass of bluenose does exist, then the assessment stock status should again be biased low and is precautionary.

Variable YCS were not estimated. Ageing of bluenose is relatively difficult, life history and population parameters are not well known, and sampled age compositions are noisy. The steepness of the stock-recruitment relationship is unknown. The stock was estimated to have recently started rebuilding following a prolonged fish-down. The better fit to recent CPUE indices achieved with a lower assumed h could be, as assumed, due to relatively weak density-dependent compensation, but in this instance it might also be aliasing for a period of low recent YCS, perhaps resulting from unfavourable recent environmental conditions. Further observations of catch and CPUE, as the stock rebuilds, are required to better inform the productivity assumption.

5. FUTURE RESEARCH CONSIDERATIONS

- Incorporate estimated recreational catches in the assessment model.
- Continue to investigate how best to incorporate weight composition (packing) data in future stock assessments. Explore potential to collect this type of data more broadly if deemed to be useful. Explore the spatial pattern of data with stat areas, and the potential for length sampling of fish within the bin data.
- Create an age determination protocol, including creating a reference set of otoliths with agreed ages, to ensure that BNS ageing remains consistent over time.
- Develop otolith sampling programmes to obtain representative samples for estimating recruitment strength.
- Collect biological samples (including otoliths) from trawl vessels targeting BNS, BYX, and HOK.
- Revisit assumptions about historical catches, including the potential for under-reporting by trawlers in FMA 2 in the 1990s.
- Develop a programme to collect qualitative and quantitative data on changes in fishing behaviour both historically and in the future.
- Further investigate the comparability of qs between different CPUE series.
- Investigate changes in temporal and spatial trawl fishing patterns.

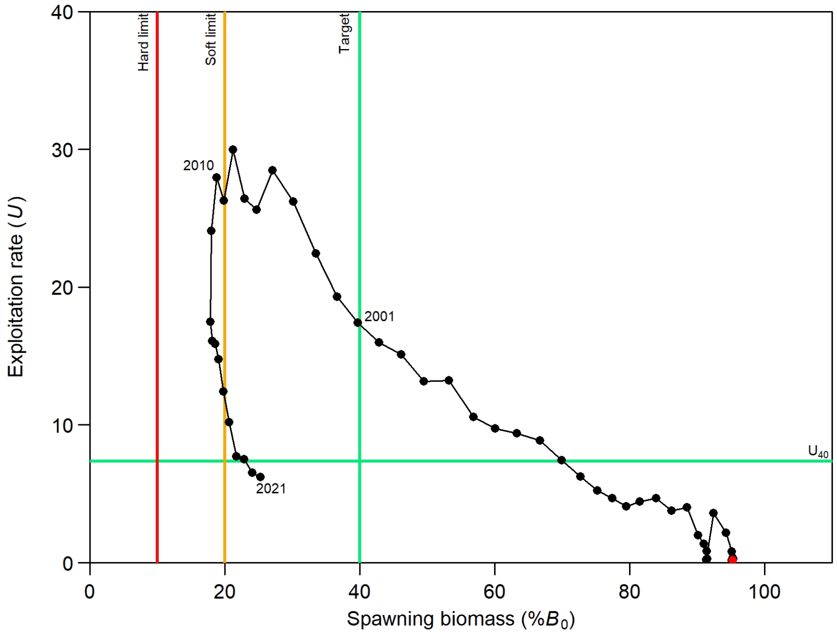
6. STATUS OF THE STOCKS

Stock Structure Assumptions
The assessment presented here assumes that bluenose in New Zealand waters comprise a single biological stock.

BNS 1, BNS 2, BNS 3, BNS 7, BNS 8, BNS 10

Stock Status	
Year of Most Recent Assessment	2021
Assessment runs presented	Base case
Reference Points	Target: 40% B_0 Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: $U_{40\%B0}$
Status in relation to Target	Very Unlikely (< 10%) to be at or above the target
Status in relation to Limits	Unlikely (< 40%) to be below the Soft Limit Very Unlikely (< 10%) to be below the Hard Limit
Status in relation to Overfishing	Overfishing is Unlikely (< 40%) to be occurring

Historical Stock Status Trajectory and Current Status



Historical trajectory of spawning biomass (% B_0) and exploitation rate (%) (base model, medians of the marginal posteriors), from 1969–70 (red point) to 2020–21. The biomass target range of 40% B_0 and the corresponding exploitation rate range are marked in green. The soft limit (20% B_0) is marked in orange and the hard limit (10% B_0) in red.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	*SSB* was estimated to have been increasing slowly since 2012.
Recent Trend in Fishing Mortality or Proxy	Exploitation rates have declined since 2010.
Other Abundance Indices	A second standardised CPUE index based on the bycatch of bluenose in the HPB longline fishery had a trend that was very similar to the trawl index.
Trends in Other Relevant Indicator or Variables	-
Stock Projections or Prognosis	Deterministic projections predict that the *SSB* will slowly increase and reach the target around the mid 2030s.
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	Very Unlikely (< 10%)

<table>
<tr><th colspan="3">Assessment Methodology and Evaluation</th></tr>
<tr><td>Assessment Type</td><td colspan="2">Level 1 - Full Quantitative Stock Assessment</td></tr>
<tr><td>Assessment Method</td><td colspan="2">Age-structured Casal2 model</td></tr>
<tr><td>Assessment Dates</td><td>Latest assessment: 2021</td><td>Next assessment: 2024</td></tr>
<tr><td>Overall assessment quality rank</td><td colspan="2">1 – High Quality</td></tr>
<tr><td>Main data inputs (rank)</td><td>- Catch history from statutory reporting
- CPUE indices derived from statutory catch and effort reporting
- Length frequency data distributions from observer data for the trawl fishery

- Age frequency distributions for the trawl and line fisheries

- Weight frequency distributions from commercial fish packing data for the longline fishery.</td><td>1 – High Quality

1 – High Quality
2 – Medium or Mixed Quality: may not be representative

2 – Medium or Mixed Quality: may not be representative

1 – High Quality</td></tr>
<tr><td>Data not used (rank)</td><td>- Length frequency distributions for the longline fishery collected under the AMP and from observer sampling.
-
- HPB target BLL standardised CPUE index.</td><td>2 – Medium or Mixed Quality: may not be representative

1 – High Quality</td></tr>
<tr><td>Changes to Model Structure and Assumptions</td><td colspan="2">- the BLL CPUE indices for each of three fisheries were split after 2001–02, 2006–07, and 2011–12
- weight composition data from commercial LFR packing data were fitted
- the assessment base model assumed two areas (background and features with a constant migration to the features) rather than one
- empirical growth reformulated</td></tr>
<tr><td>Major Sources of Uncertainty</td><td colspan="2">- Deterministic recruitment is assumed; variations in year class strengths are not estimated, and therefore stock productivity is influenced only by M and h.
- Stock structure and spatial dynamics are uncertain.
- The selectivity of the longline fisheries appears to vary annually, making it difficult to estimate temporal changes in stock productivity (recruitment strength), which has resulted in an assessment with high uncertainty.
- It is unclear whether the almost 50% reduction in TACC between 2015–16 and 2017–18 caused changes in fishing practices.</td></tr>
</table>

Qualifying Comments
Because there are inconsistencies in the observed data, uncertainty in the bluenose stock assessment is high.

Fishery Interactions
Bluenose is taken in conjunction with alfonsino in target midwater trawl fisheries directed at the latter species. These fisheries are frequently associated with undersea features. Bluenose is also taken by target bottom longline fisheries throughout the New Zealand EEZ. Other commercially important species taken when longlining for bluenose are ling, hapuku, and bass.

7. FOR FURTHER INFORMATION

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