NIWA

Taihoro Nukurangi

Climate, Freshwater & Ocean Science

[May 2019] [Chatham Rise ling stock assessment]

- Re-cap
- Final adjustments to base and sensitivity runs
- MPD results including sensitivities
- MCMC results
- Projections

Recap: Estimated parameters

	Base	Alternative
B_0 (Initial biomass (t))	Uniform-log prior (30 000, 500 000)	
M (natural mortality)	~~Constant M, no difference between sexes. Uniform prior (0.01, 0.6)~~ Constant M, difference between sexes Average has lognormal prior, μ=0.2, c.v.=0.18 (0.06, 0.5) Difference has normal prior, μ=0, σ=0.05 (-0.1, 0.1)	2019 ⟷ ~~Constant M, difference between sexes~~ ~~Average has lognormal prior, μ=0.2, c.v.=0.18 (0.06, 0.5)~~ ~~Difference has normal prior, μ=0, σ=0.05 (-0.1, 0.1)~~ Constant M, no difference between sexes. Uniform prior (0.01, 0.6)
P_male (proportion of recruits that are male)	~~Constant with normal prior, μ=0.5, c.v.=0.15 (0.1, 0.9)~~ 2019: Fixed at 0.5	
Selectivity (trawl fishery and survey)	Double normal (capped for males) with uniform prior a_1(1,20), s_L(1,50), s_R(1,200), a_{max}(0,5)	logistic (capped for males), with uniform prior a_{50}(1,20), a_{to95}(1,200), a_{max}(0,5)
Selectivity (longline fishery)	logistic with uniform prior a_{50}(1,20), a_{to95}(1,200) – sexes combined	Double normal with uniform prior a_1(1,20), s_L(1,200), s_R(1,200) – sexes combined
YCS (year class strengths)	Lognormal prior, μ=1, c.v.=0.7 (0.01, 100)	
Survey catchability q	Lognormal prior, μ=0.13, c.v.=0.7 (0.02, 0.3)	Lognormal prior, μ=0.6, c.v.=0.7 (0.005, 0.9) Lognormal prior, μ=0.6, c.v.=0.3 (0.005, 0.9)

Recap: adjustments to base case runs

Key run assumptions	B_0 (t)	$\%B_0$
1. Base run. As last assessment except new maturity ogive; EFS calculated after allowing for estimation of year class strength	107 699	49
1a. Base run. YCS in 2015 forced to 1	108 714	51
1b. Base run. YCS in 2015 forced to 1; 'p_male' fixed at 0.5	108 221	49
1c. Base run. YCS in 2015 forced to 1; 'p_male' fixed at 0.5; 1990 survey proportions at age removed	108 136	49
1e. Base run. YCS in 2015 forced to 1; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; survey abundance process error estimated (estimated value 0.087)	114 506	54
1f. Base run (final base run of meeting 2). YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; survey abundance process error estimated & then ESS re-estimated (estimated survey process error 0.08)	113 398	55
1d. Base run. YCS in 2015 forced to 1; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; proportions at age in longline fishery separated by sex	100 537	43
New **1d2. Base run.** YCS in 2015 forced to 1; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; M separate by sex; longline proportions at age separated by sex; longline proportions at length removed; survey abundance process error estimated (estimated survey process error 0.08)	112 788	55
New **1g. Base run.** YCS in 2015 forced to 1; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; M separate by sex; longline proportions at age separated by sex; longline proportions at length removed; survey abundance process error estimated & then ESS re-estimated (Run 1d2 used to estimate survey p.e. and for ESS estimation)	113 068	55

Sensitivities: estimated B_0(t) and $B_{current}$(%B_0) – adjustments to CPUE runs

Key run assumptions	B_0 (t)	%B_0
1f. Base run (meeting 2). YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; survey abundance process error estimated & then ESS re-estimated (estimated survey process error 0.08)	113 398	55
1g. Base run. YCS in 2015 forced to 1; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; M separate by sex; longline proportions at age separated by sex; longline proportions at length removed; survey abundance process error estimated & then ESS re-estimated (Run 1d2 used to estimate survey p.e. and for ESS estimation)	113 068	55
2d. CPUE run (final 'run 2' of meeting 2). YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; proportions at age data for survey removed; CPUE abundance process error estimated & then ESS re-estimated	93 222	33
New **2e. CPUE run.** YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; proportions at age data for survey removed; M separate by sex; longline proportions at age separated by sex; longline proportions at length removed; CPUE abundance process error estimated (estimated CPUE process error 0.104)	91 355	32
New **2f. CPUE run.** YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; proportions at age data for survey removed; M separate by sex; longline proportions at age separated by sex; longline proportions at length removed; CPUE abundance process error estimated & then ESS re-estimated (Run 2e used to estimate survey p.e. and for ESS estimation)	91 470	32

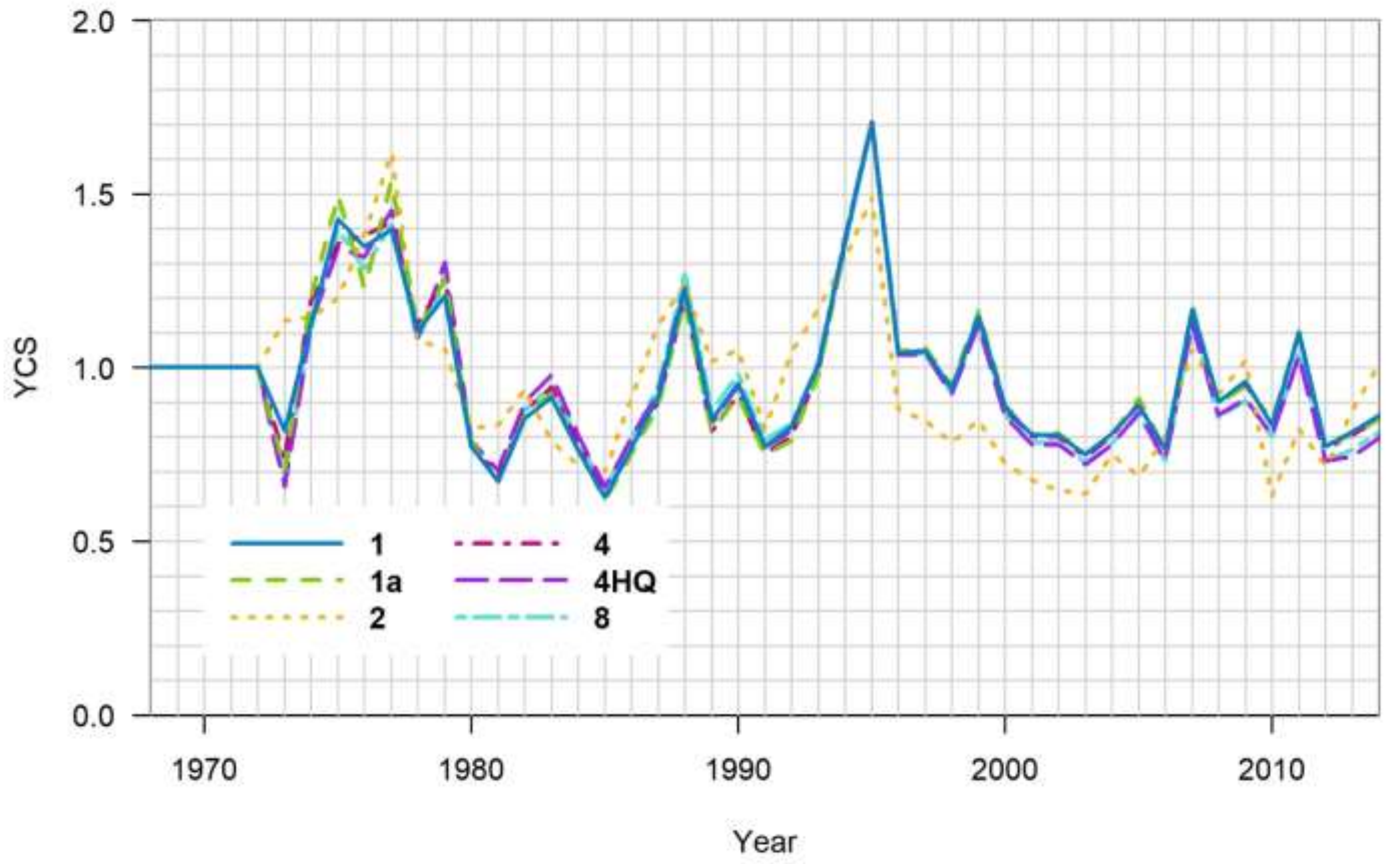
Sensitivities: estimated B_0(t) and $B_{current}$(%B_0) – longline ages (& lengths) by sex

Key run assumptions	B_0 (t)	%B_0
1d. Base run. YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; proportions at age in longline fishery separated by sex	100 537	43
4. M run. Same as Base run (run 1), but M separate by sex	109 354	53
4a. M run. YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; 1990 survey proportions at age removed	107 823	52
4b. M run. YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; proportions at age in longline fishery separated by sex	108 678	51
4c. M run. YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; proportions at age in longline fishery separated by sex; proportions at length in longline fishery separated by sex	105 793	49
4d. M run (final 'run 4' of meeting 2). YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; proportions at age in longline fishery separated by sex; proportions at length in longline fishery separated by sex; survey abundance process error estimated & then ESS re-estimated	109 670	53
New **4e. M run.** YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; proportions at age in longline fishery separated by sex; proportions at length in longline fishery separated by sex; survey abundance process error estimated; survey q prior initial μ = 0.6 (CV 30%) (estimated survey process error 0.11) (survey q estimated at 0.12)	102 805	44
New **4f. M run.** YCS in 2015 forced to 1 ; 'p_male' fixed at 0.5; 1990 survey proportions at age removed; proportions at age in longline fishery separated by sex; proportions at length in longline fishery separated by sex; survey abundance process error estimated; survey q prior initial μ = 0.6 (CV 30%); ESS re-estimated. (survey process error fixed at run 4e value) (survey q estimated at 0.11)	100 840	44

Sensitivities: estimated B_0(t) and $B_{current}$(%B_0) – final sensitivities

Key run assumptions	B_0 (t)	%B_0	p.e. (survey)	p.e. (CPUE)
1g. Base run. YCS in 2015 forced to 1; ‘p_male’ fixed at 0.5; 1990 survey proportions at age removed; M separate by sex; longline proportions at age separated by sex; longline proportions at length removed; survey abundance process error estimated & then ESS re-estimated (Run 1d2 used to estimate survey p.e. and for ESS estimation)	113 068	55	0.080	
1f. Base run (single sex M and LL props. At age). ‘Old base’ YCS in 2015 forced to 1 ; ‘p_male’ fixed at 0.5; 1990 survey proportions at age removed; survey abundance process error estimated & then ESS re-estimated	113 398	55	0.080	
2f. CPUE run. YCS in 2015 forced to 1 ; ‘p_male’ fixed at 0.5; proportions at age data for survey removed; M separate by sex; longline proportions at age separated by sex; longline proportions at length removed; CPUE abundance process error estimated & then ESS re-estimated (Run 2e used to estimate survey p.e. and for ESS estimation)	91 470	32		0.104
4d. M run (retains Longline proportions at length). YCS in 2015 forced to 1 ; ‘p_male’ fixed at 0.5; 1990 survey proportions at age removed; M separate by sex; longline proportions at age separated by sex; longline proportions at length separated by sex; survey abundance process error estimated & then ESS re-estimated	109 670	53	0.085	
4f. M run (high q, informed) (retains Longline proportions at length). YCS in 2015 forced to 1 ; ‘p_male’ fixed at 0.5; 1990 survey proportions at age removed; longline proportions at age separated by sex; longline proportions at length separated by sex; survey abundance process error estimated; survey q prior initial μ = 0.6 (CV 30%); ESS re-estimated. (Run 4e used to estimate survey p.e. and for ESS estimation) (survey q estimated at 0.11)	100 840	44	0.11	
8c. High q (informed) run. YCS in 2015 forced to 1 ; ‘p_male’ fixed at 0.5; 1990 survey proportions at age removed; M separate by sex; longline proportions at age separated by sex; longline proportions at length removed; survey q prior initial μ = 0.6 (CV 30%); survey abundance process error estimated & then ESS re-estimated (Run 8b2 used to estimate survey p.e. and for ESS estimation) (survey q estimated at 0.115)	102 953	44	0.109	

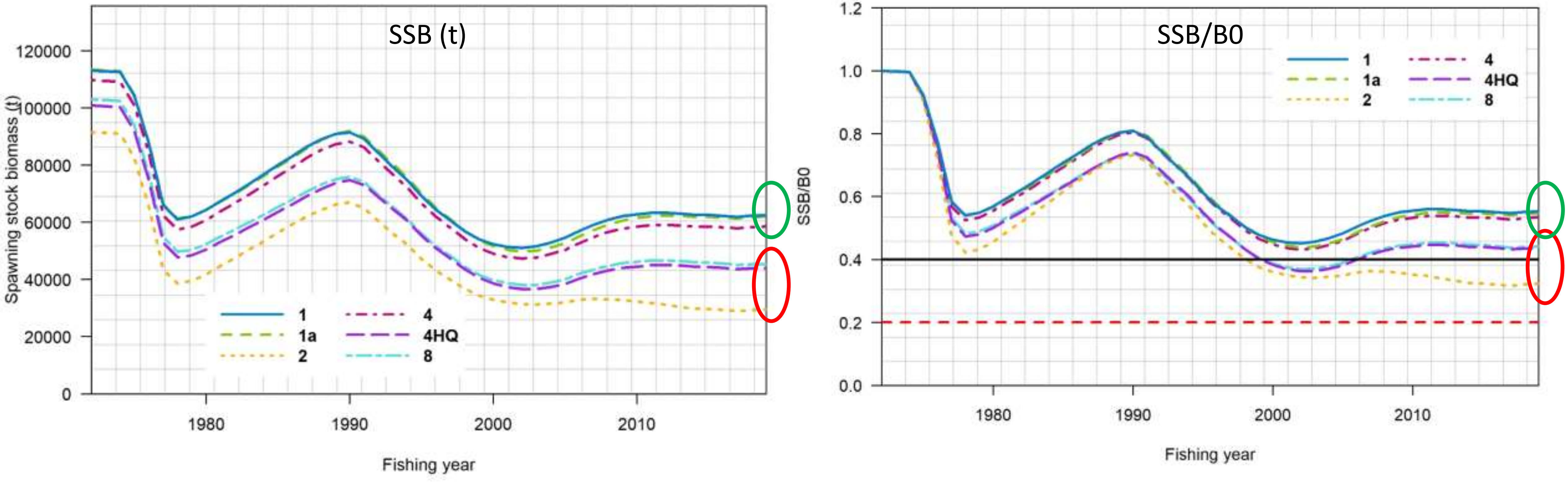
MPD estimates for YCS (year class strengths)



1. Base 1a. Old base 2. Longline 4. M 4HQ. M+Survey q(2) 8. Base+Survey q (2)

MPD estimates for SSB

1. Base   1a. Old base   2. Longline   4. M   4HQ. M+Survey q(2)   8. Base+Survey q (2)

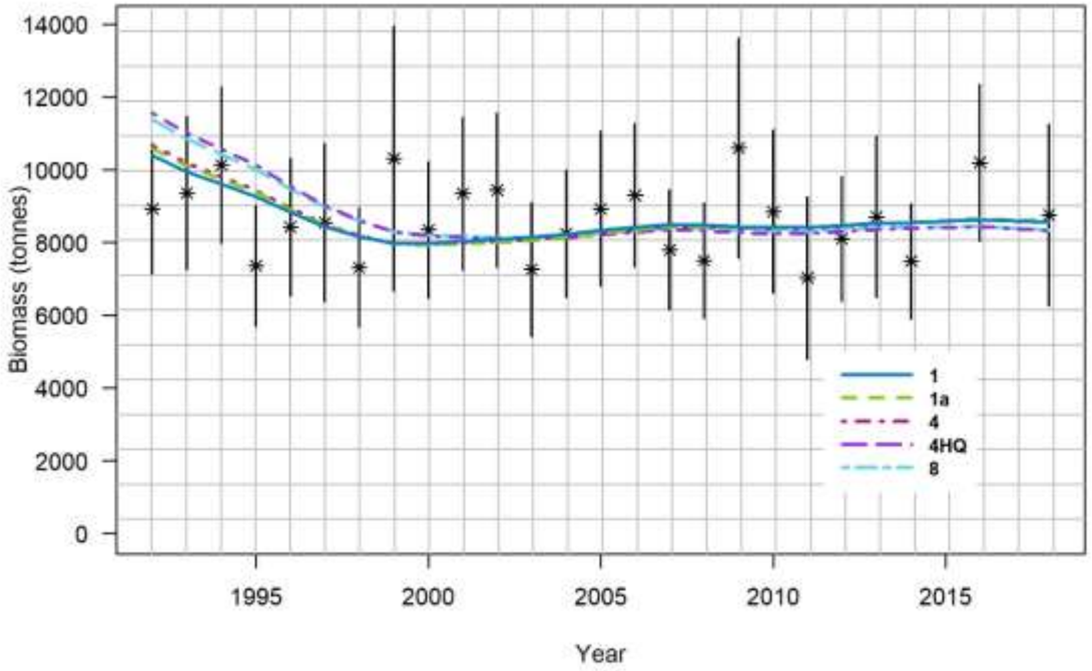


CPUE included or high(er) survey q

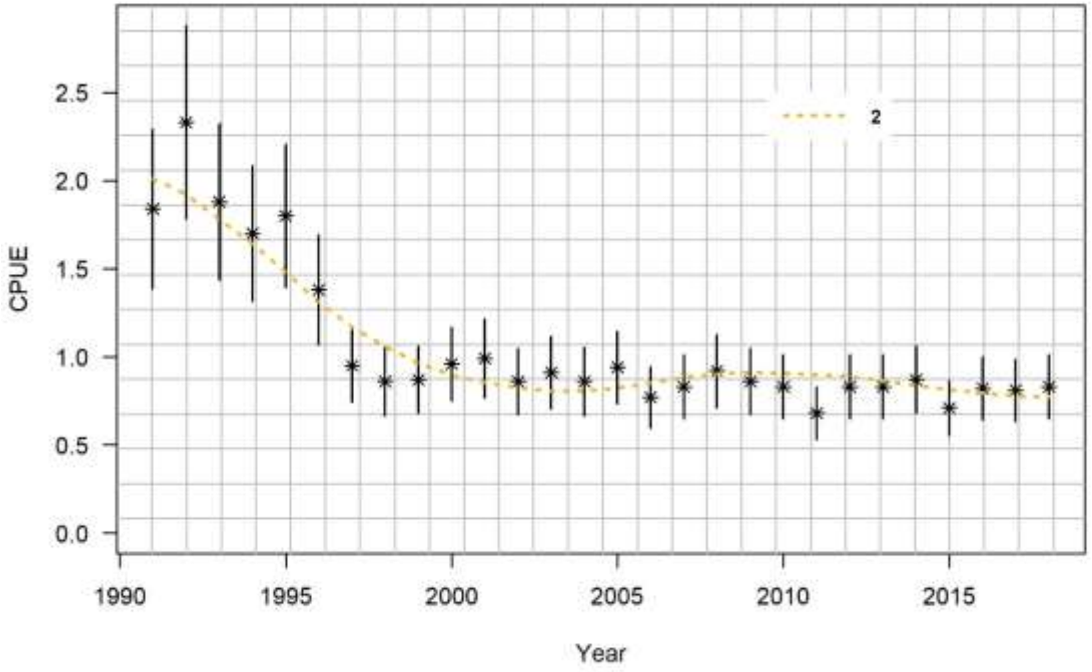
CPUE excluded & selectivity dnorm (trawl), logistic (LL) & uncertain prior on survey q

MPD fits to abundance indices

Trawl survey abundance index



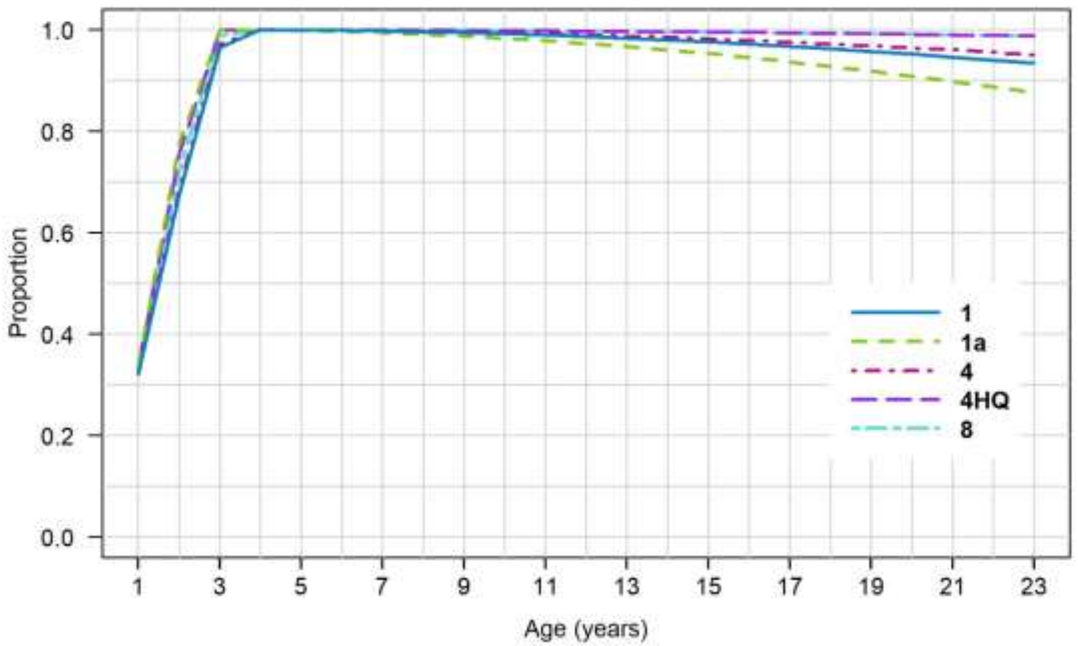
Longline CPUE



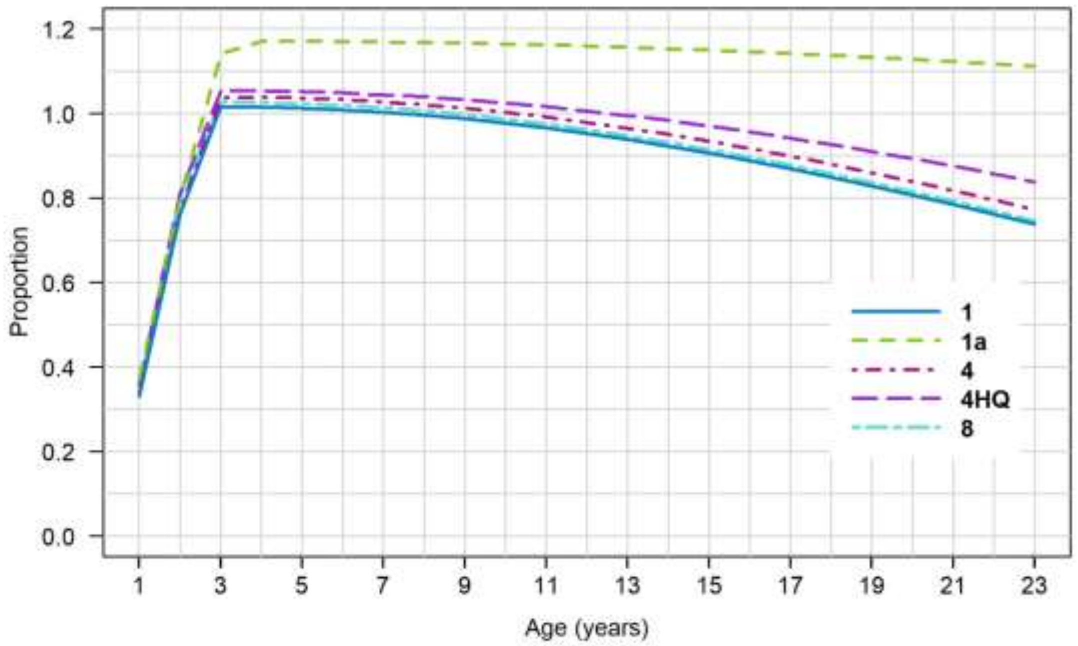
1. Base 1a. Old base 2. Longline 4. M 4HQ. M+Survey q(2) 8. Base+Survey q (2)

MPD estimates for selectivity (trawl survey)

Female



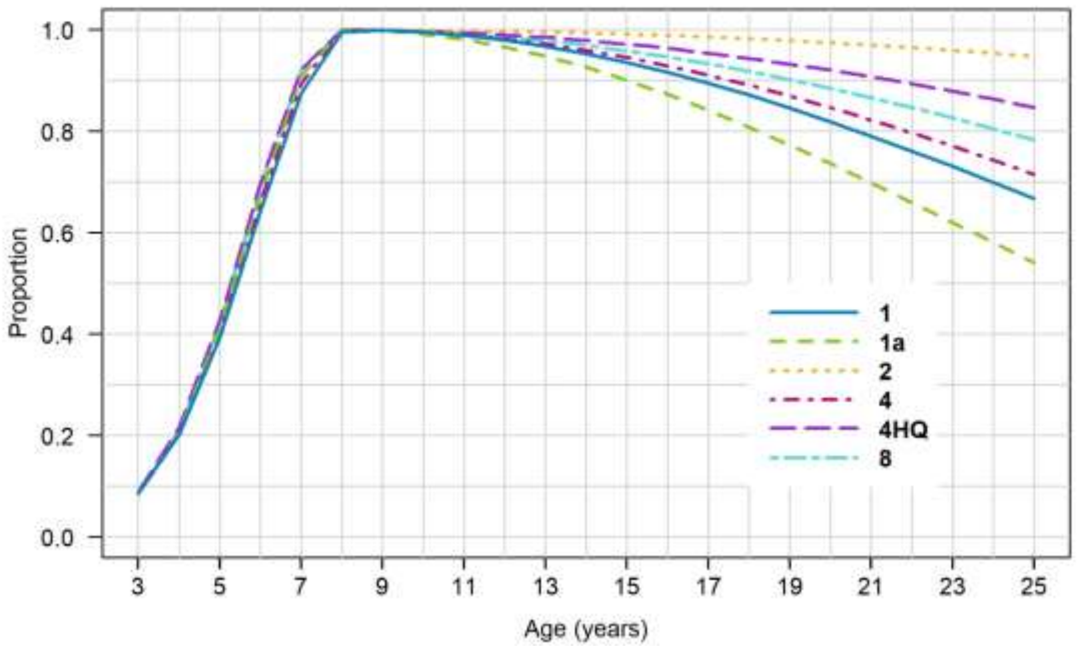
Male



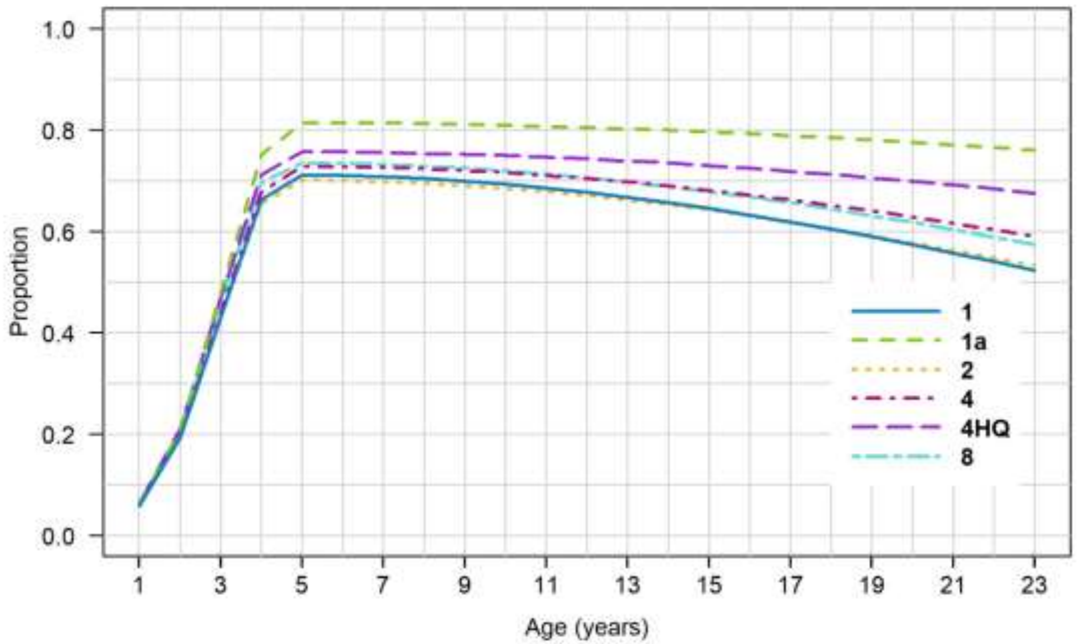
1. Base   1a. Old base   ~~2. Longline~~   4. M   4HQ. M+Survey q(2)   8. Base+Survey q (2)

MPD estimates for selectivity (trawl fishery)

Female



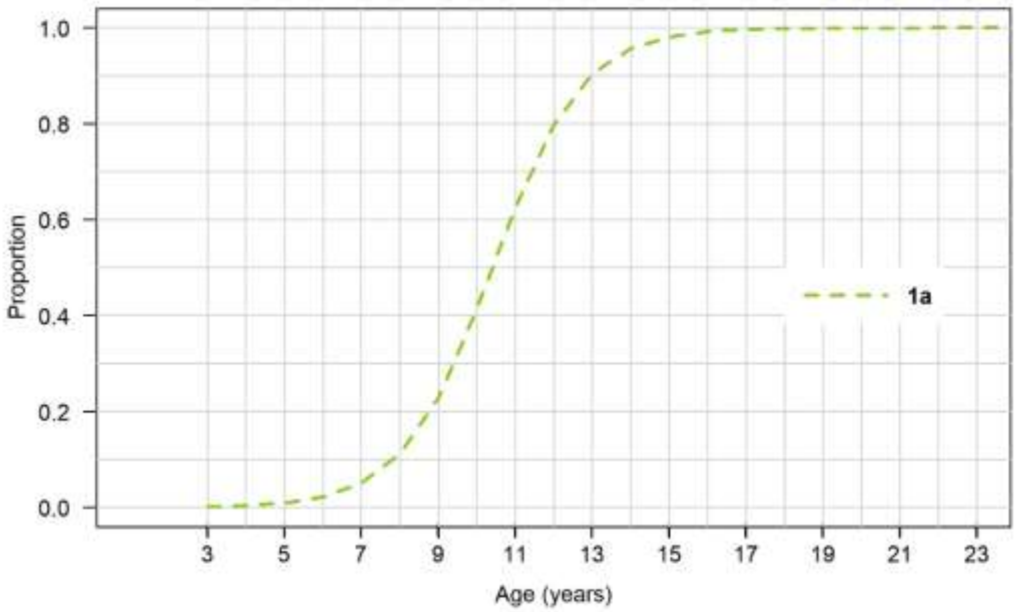
Male



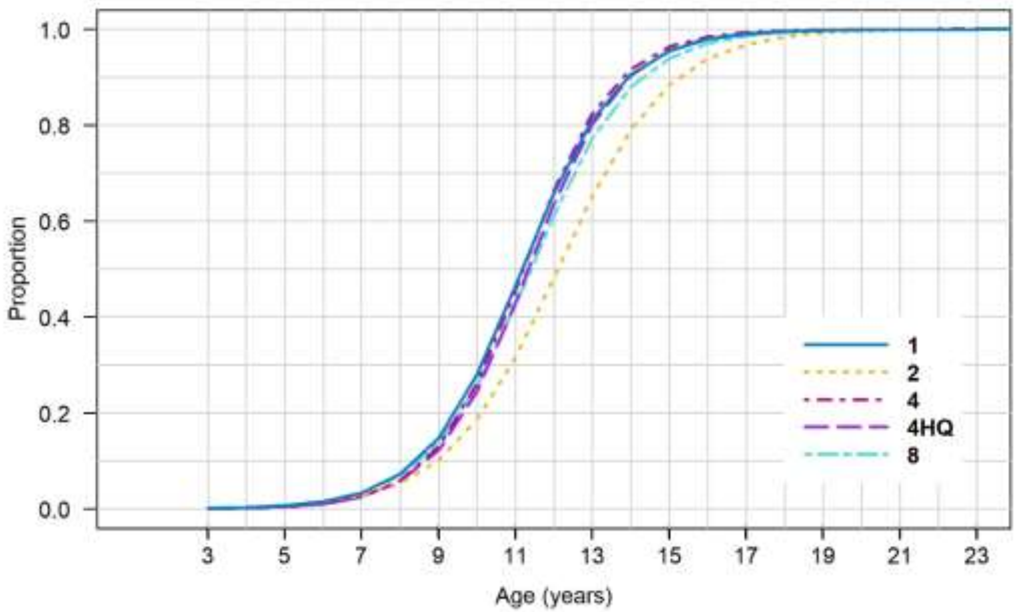
1. Base 1a. Old base 2. Longline 4. M 4HQ. M+Survey q(2) 8. Base+Survey q (2)

MPD estimates for selectivity (longline fishery)

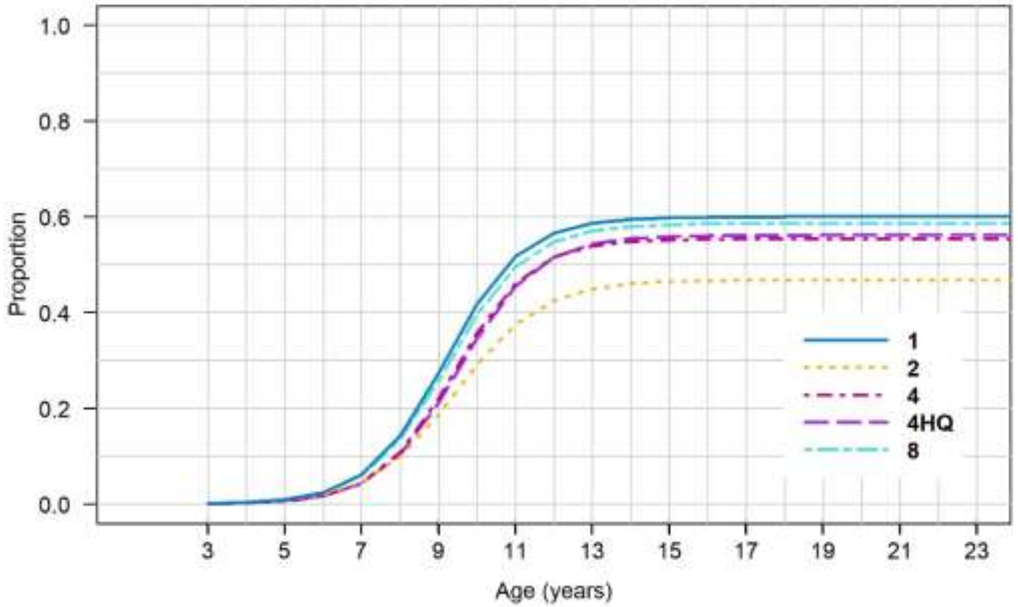
Combined sexes



Female



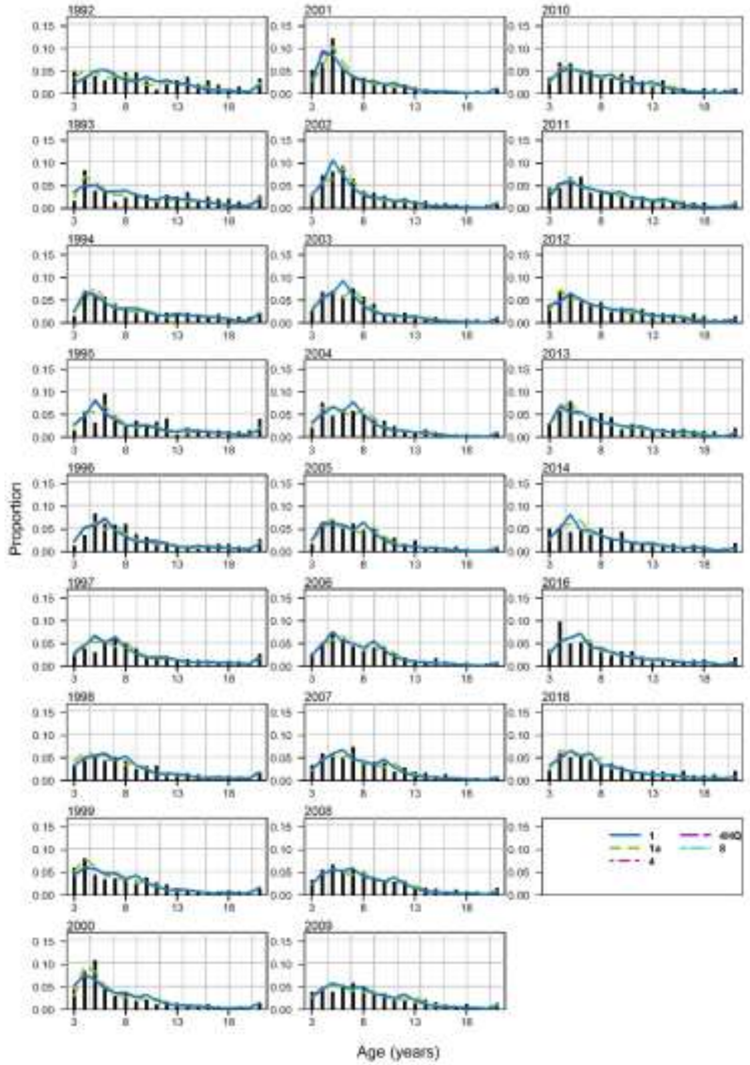
Male

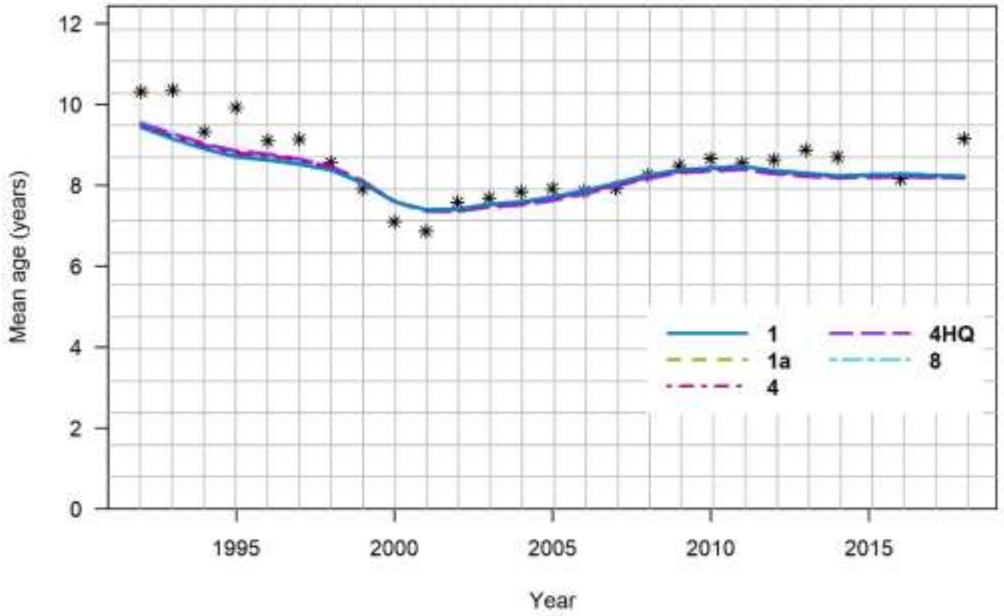


1. Base 1a. Old base 2. Longline
4. M 4HQ. M+Survey q(2) 8. Base+Survey q (2)

MPD fits to composition data – trawl survey

Female

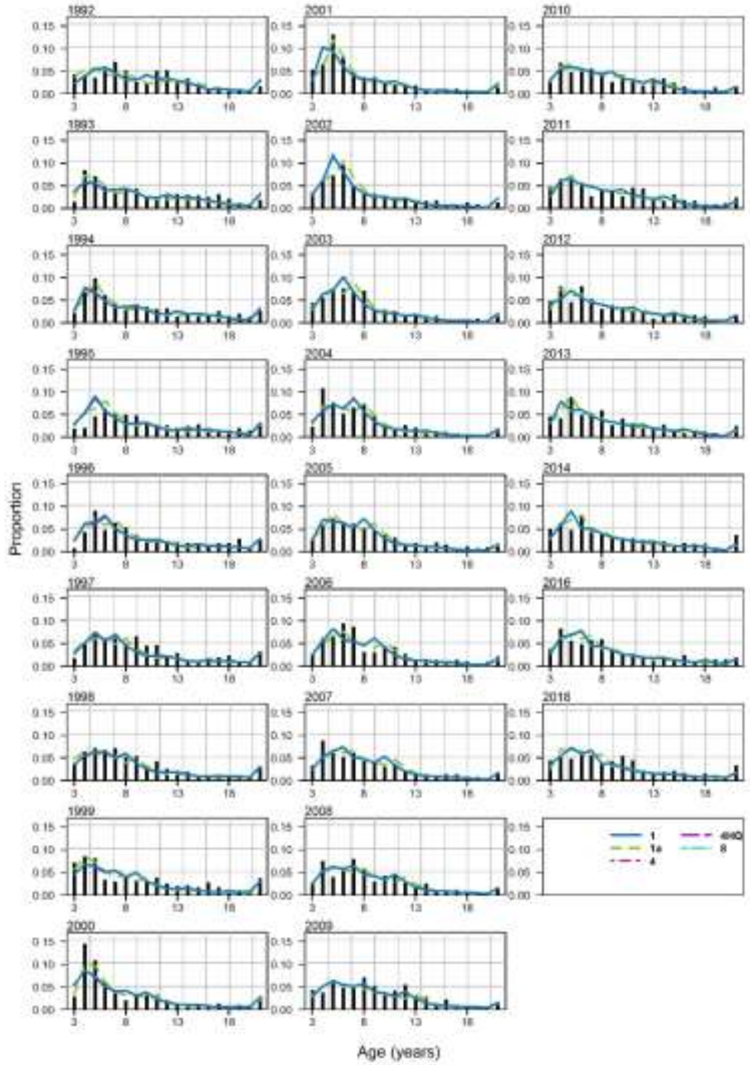


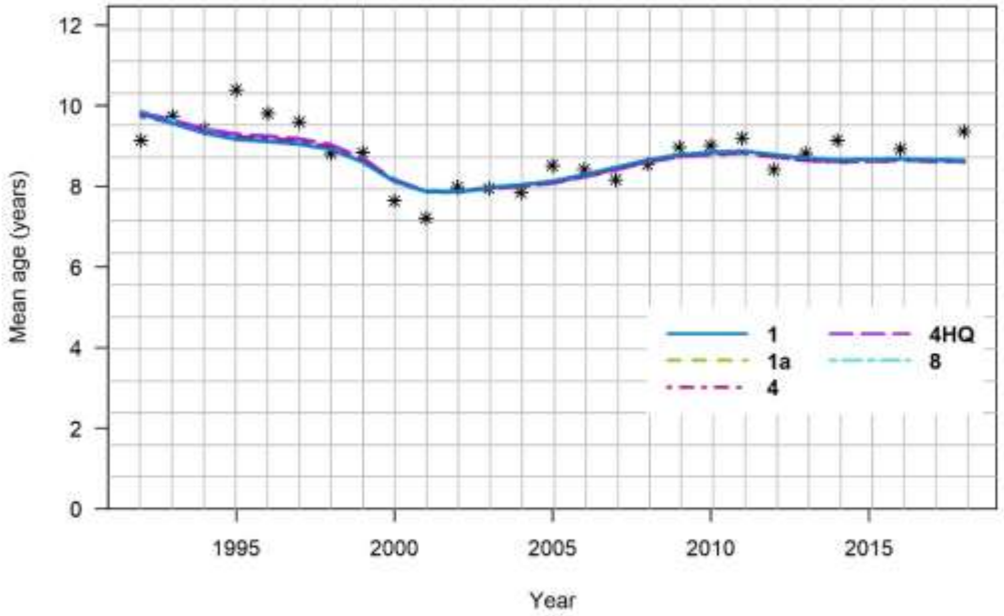


1. Base 1a. Old base ~~2. Longline~~
4. M 4HQ. M+Survey q(2) 8. Base+Survey q (2)

MPD fits to composition data – trawl survey

Male

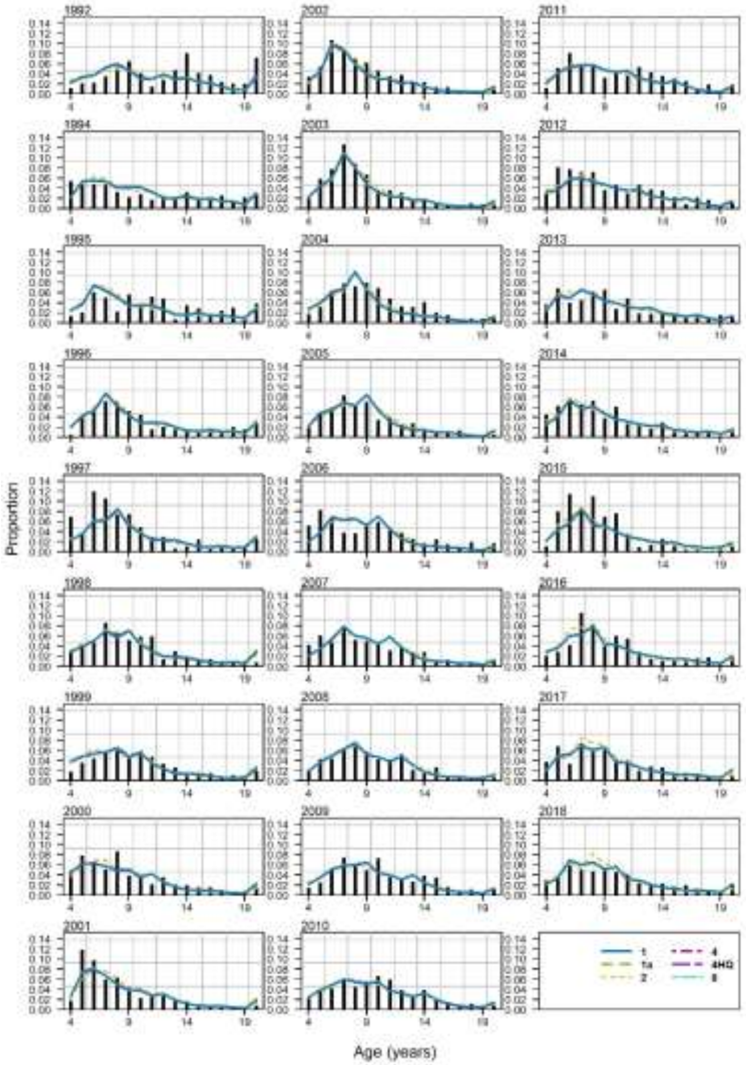


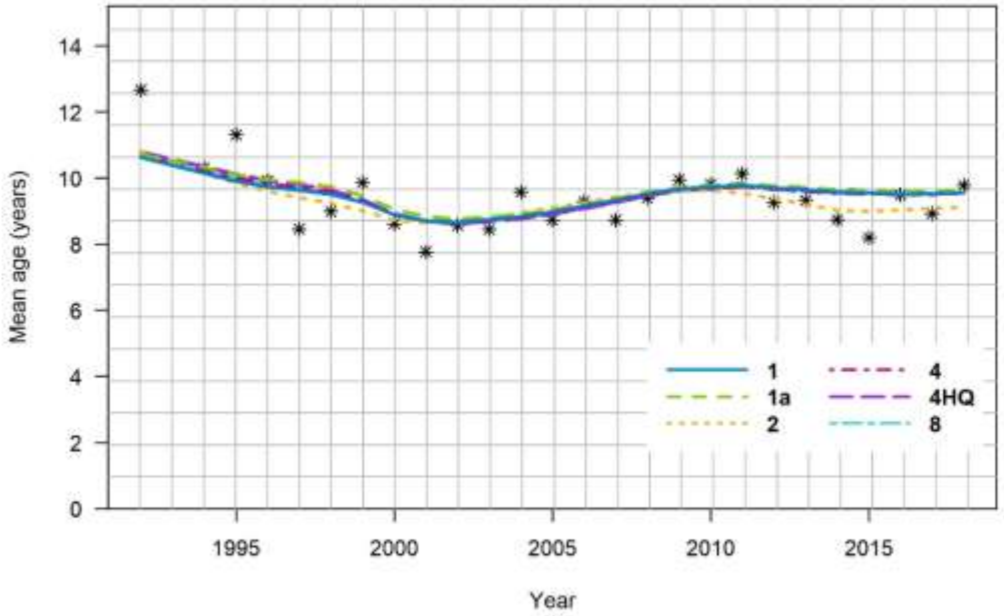


1. Base 1a. Old base ~~2. Longline~~
4. M 4HQ. M+Survey q(2) 8. Base+Survey q (2)

MPD fits to composition data – trawl fishery

Female





1. Base
1a. Old base
2. Longline
4. M
4HQ. M+Survey q(2)
8. Base+Survey q (2)

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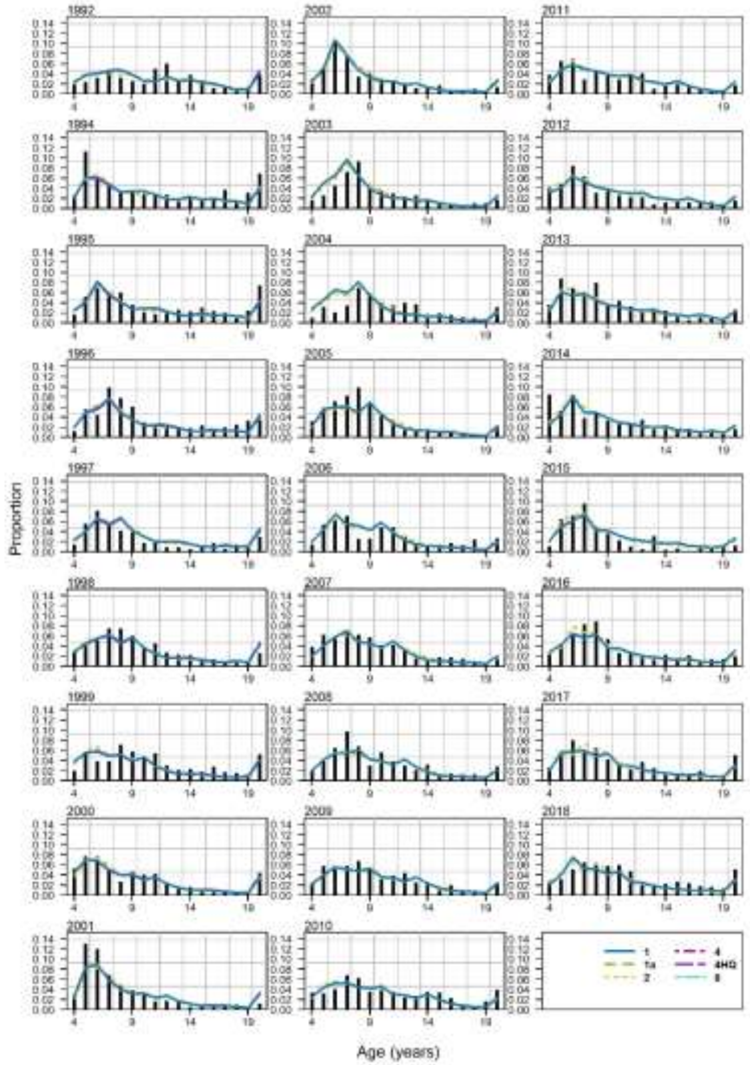
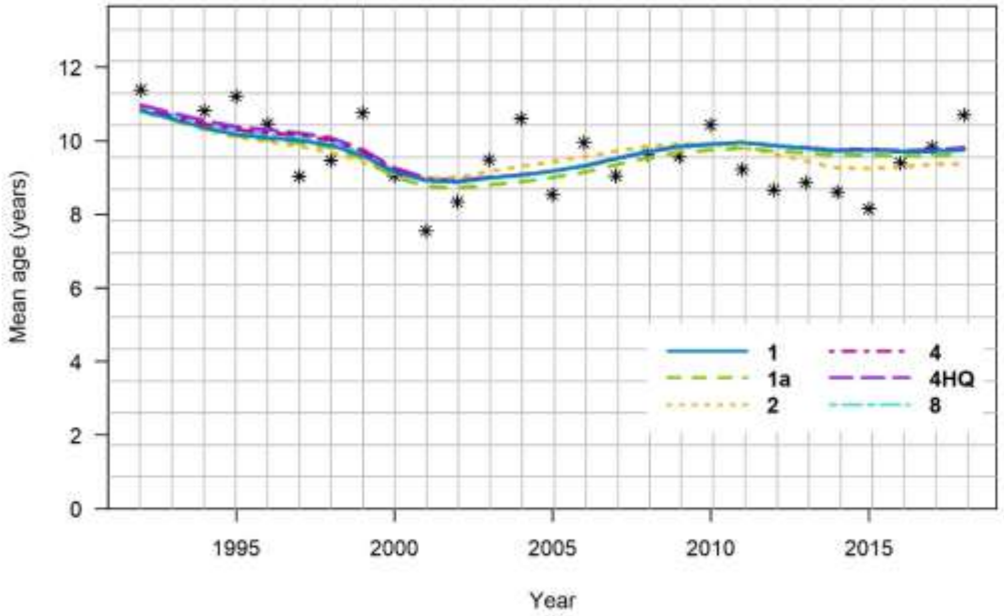
MPD fits to composition data – trawl fishery

Male





1. Base   1a. Old base   2. Longline
4. M   4HQ. M+Survey q(2)   8. Base+Survey q (2)

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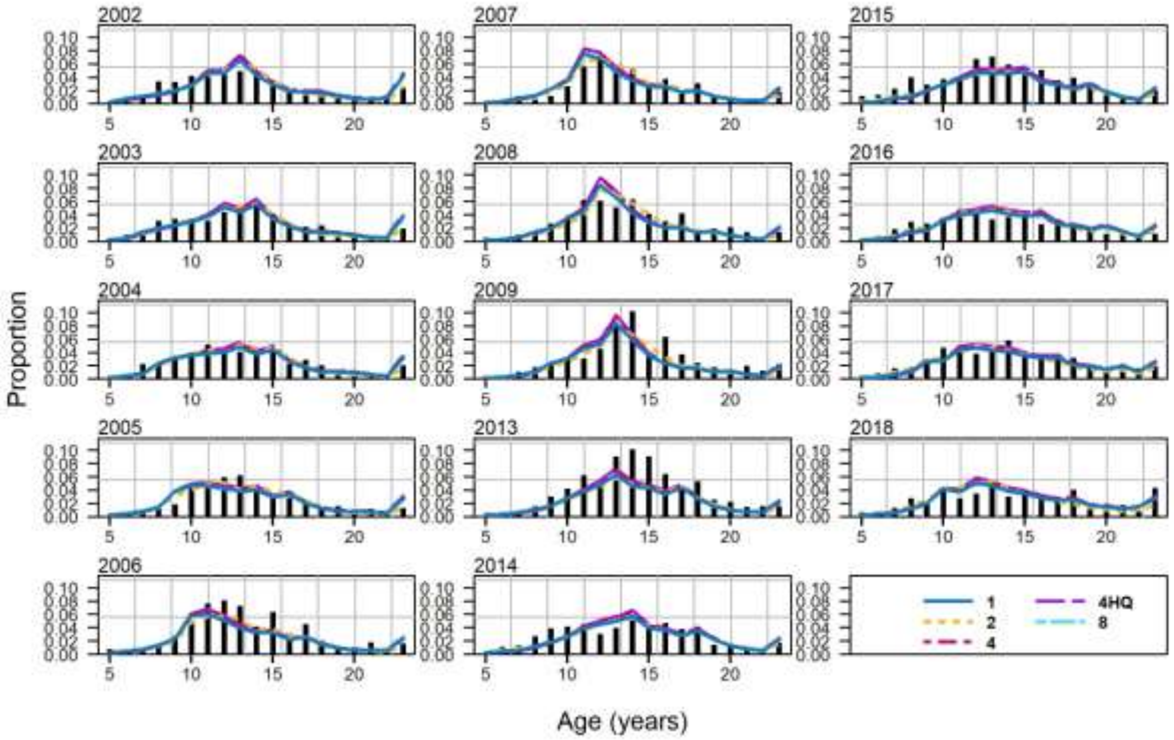
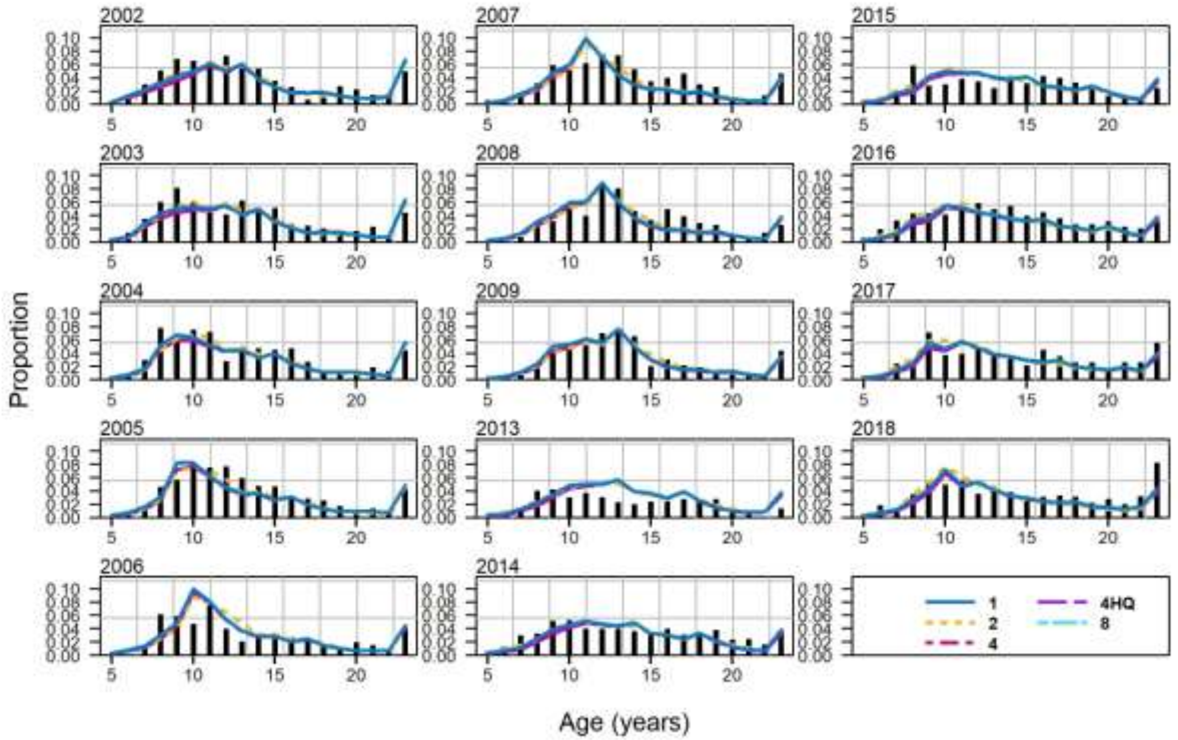
MPD fits to composition data – longline fishery – proportion at age

Female



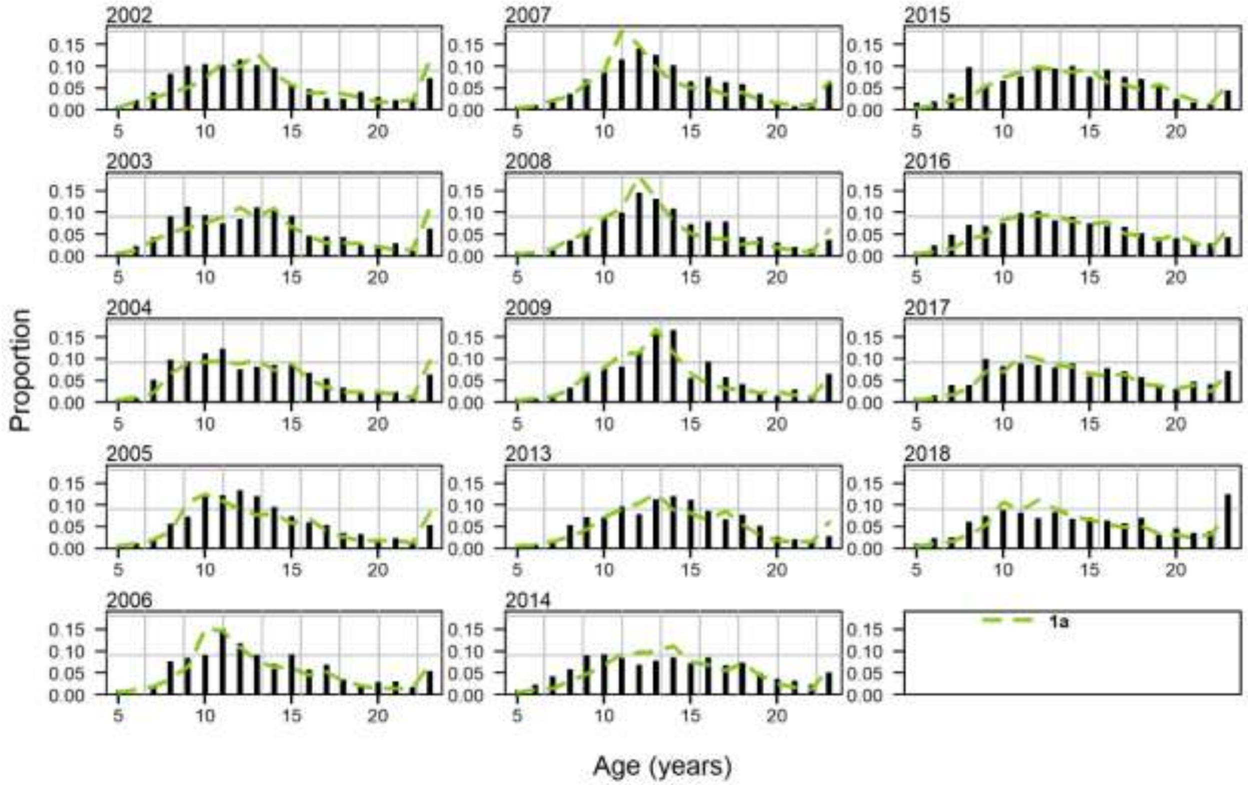
Male

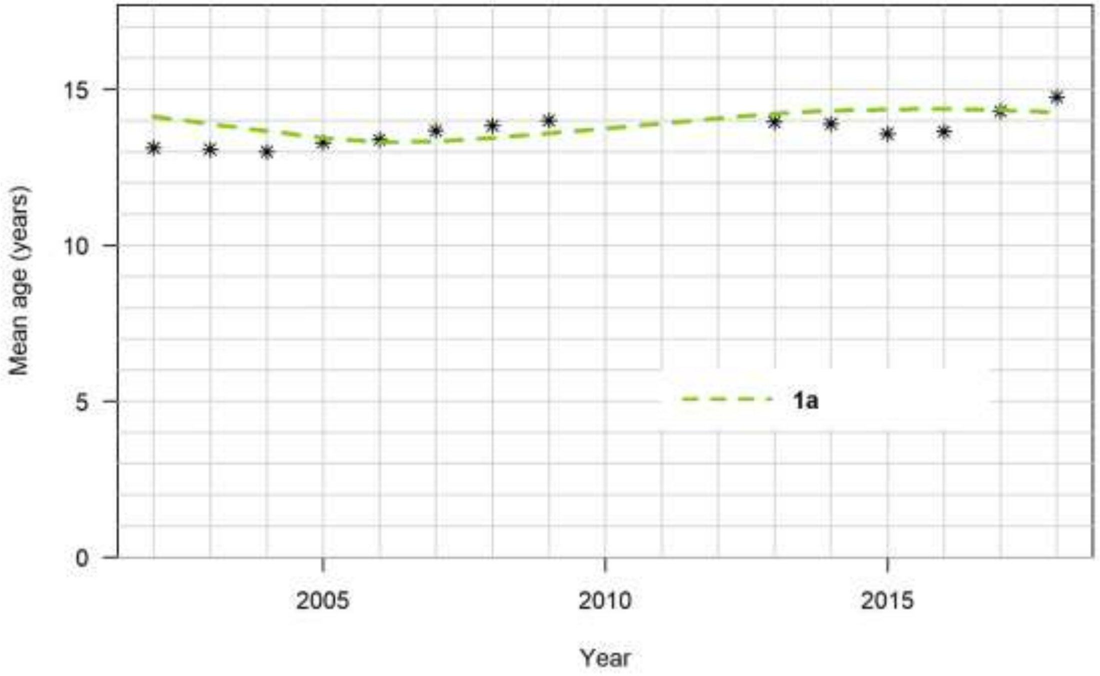


1. Base	~~1a. Old base~~	2. Longline
4. M	4HQ. M+Survey q(2)	8. Base+Survey q (2)

MPD fits to composition data – longline fishery

Proportion at age (combined sexes)



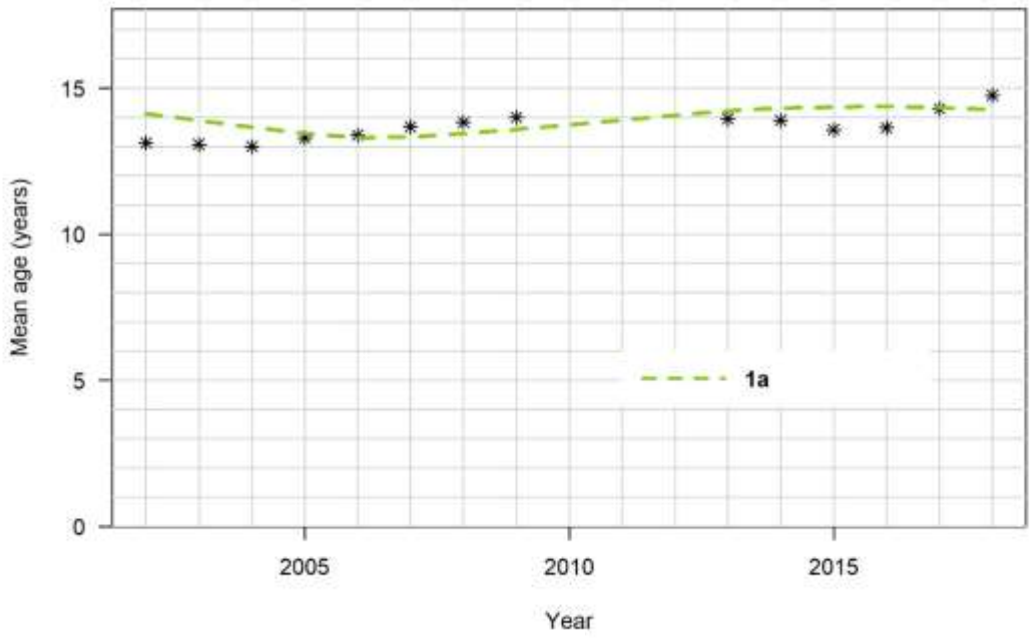


~~1. Base~~ 1a. Old base ~~2. Longline~~

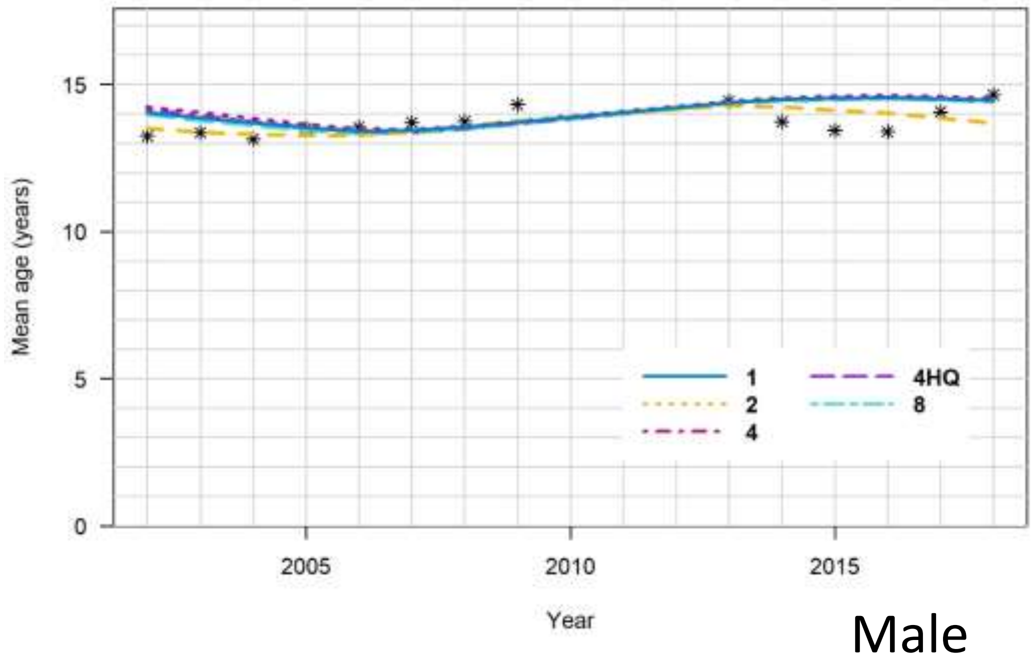
~~4. M~~ ~~4HQ. M+Survey q(2)~~ ~~8. Base+Survey q (2)~~

MPD fits to composition data – longline fishery
Mean age

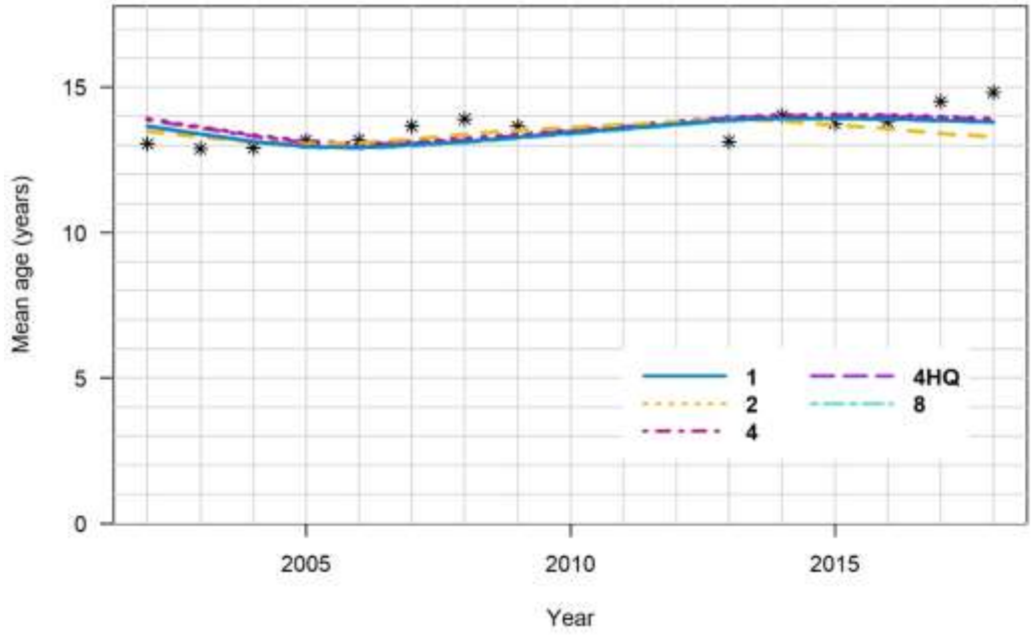
Combined sexes



Female



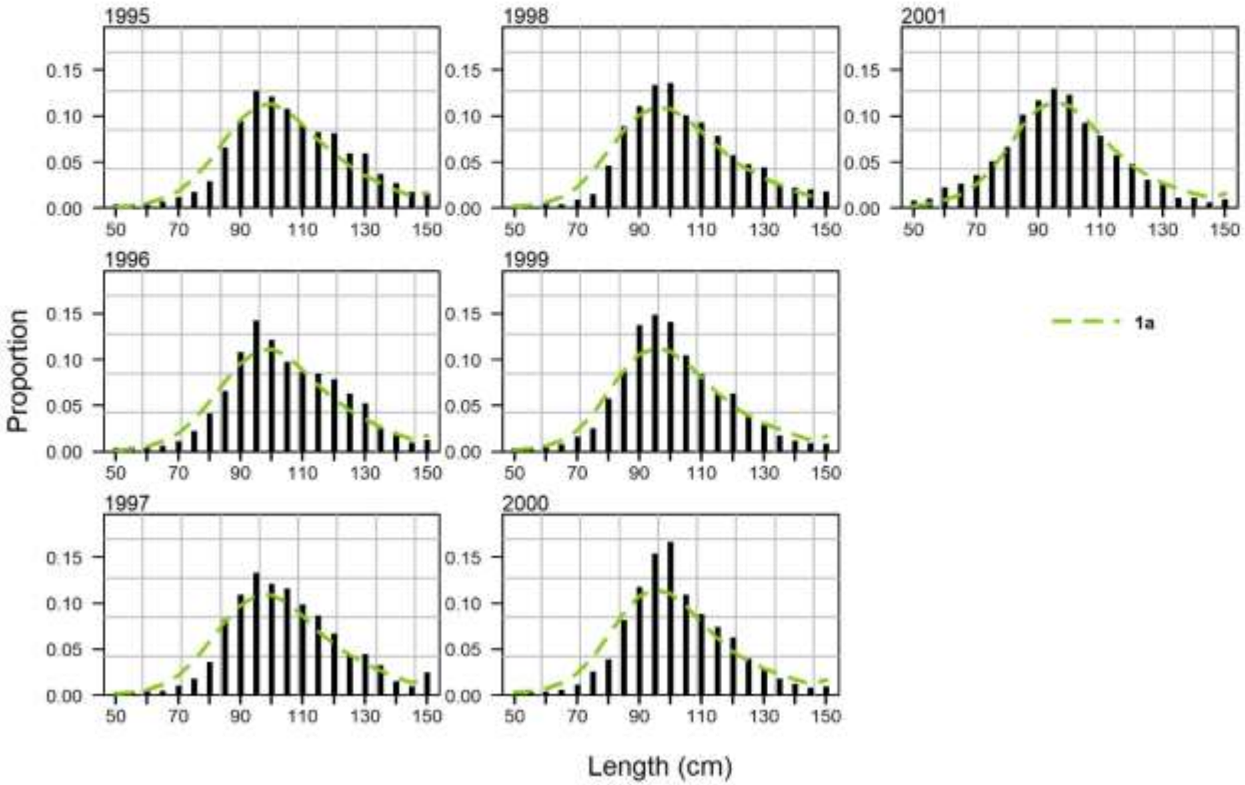
Male

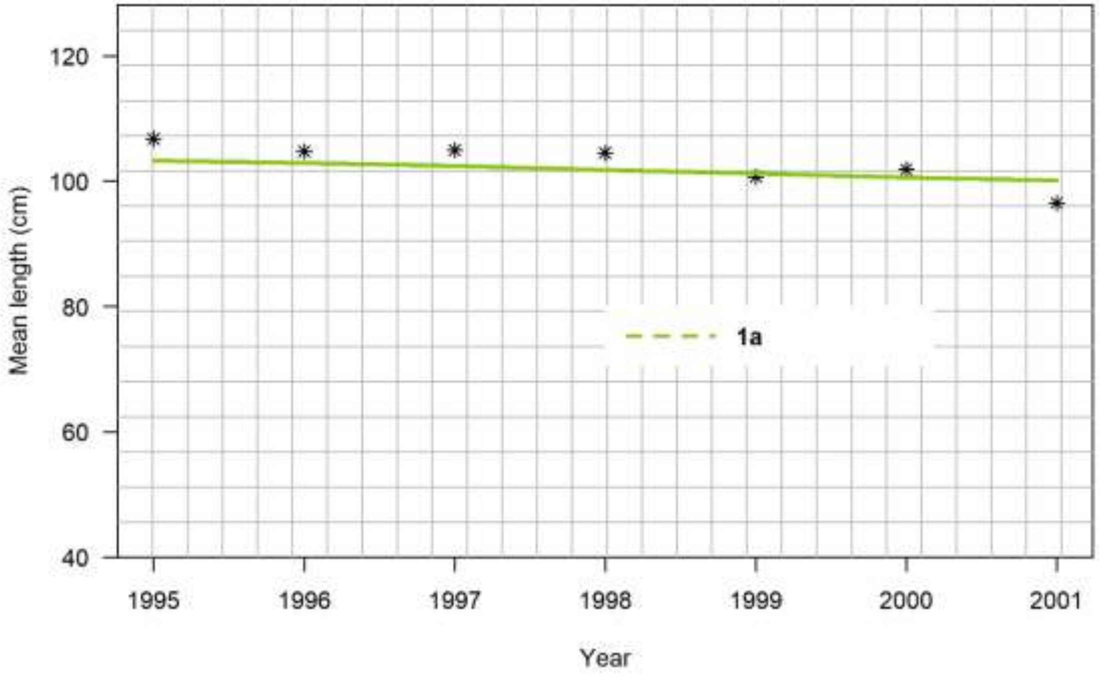


1. Base
1a. Old base
2. Longline
4. M
4HQ. M+Survey q(2)
8. Base+Survey q (2)

MPD fits to composition data – longline fishery

Proportion at length (combined sexes)





~~1. Base~~ 1a. Old base ~~2. Longline~~ ~~4. M~~ ~~4HQ. M+Survey q(2)~~ ~~8. Base+Survey q (2)~~

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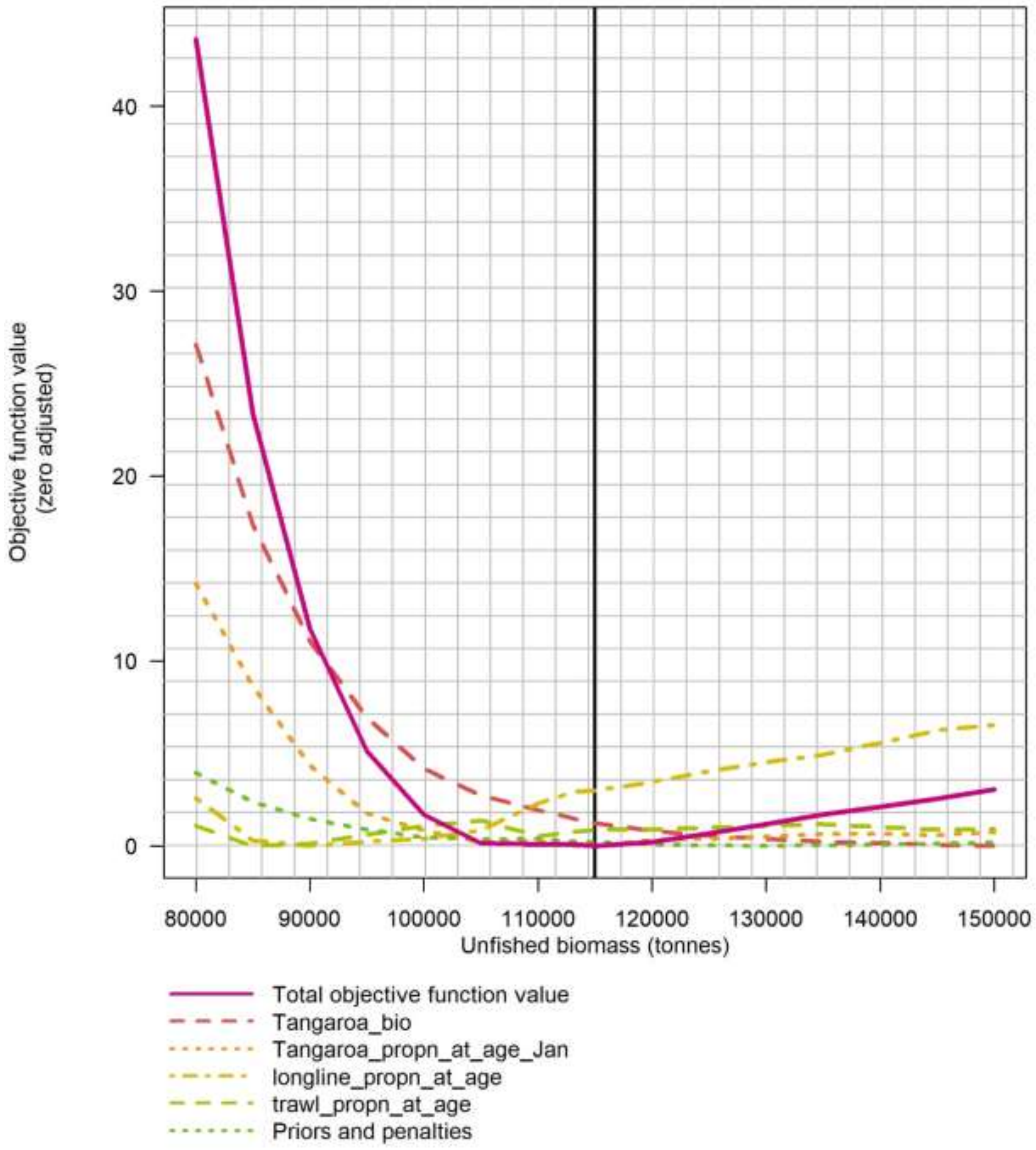
MPD estimates for M & survey q

	M (all)	M (male)	M (female)	Survey q
Base run (1g)		0.13	0.15	0.09
Old Base run (1f)	0.13			0.08
CPUE run (2f)		0.12	0.14	na
M run (4d)		0.14	0.15	0.09
M run, high survey q (4HQ)		0.13	0.14	0.11
High q (informed) (8c)		0.12	0.14	0.115

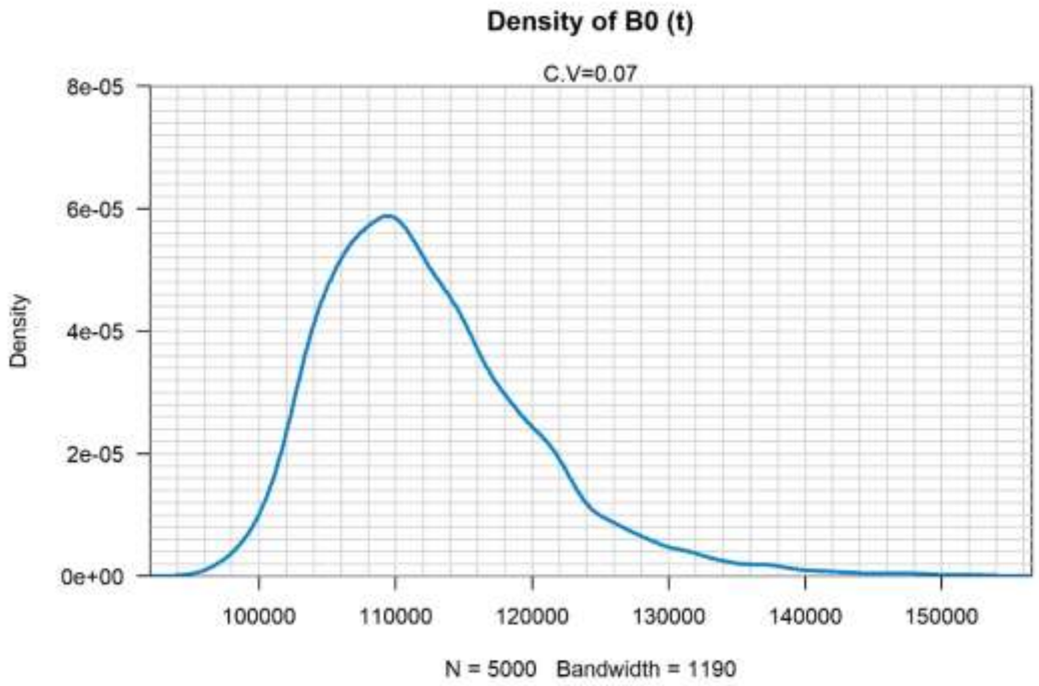
Estimates of M very consistent between runs and match closely with studies of M derived from life-history parameters (Edwards, 2017)

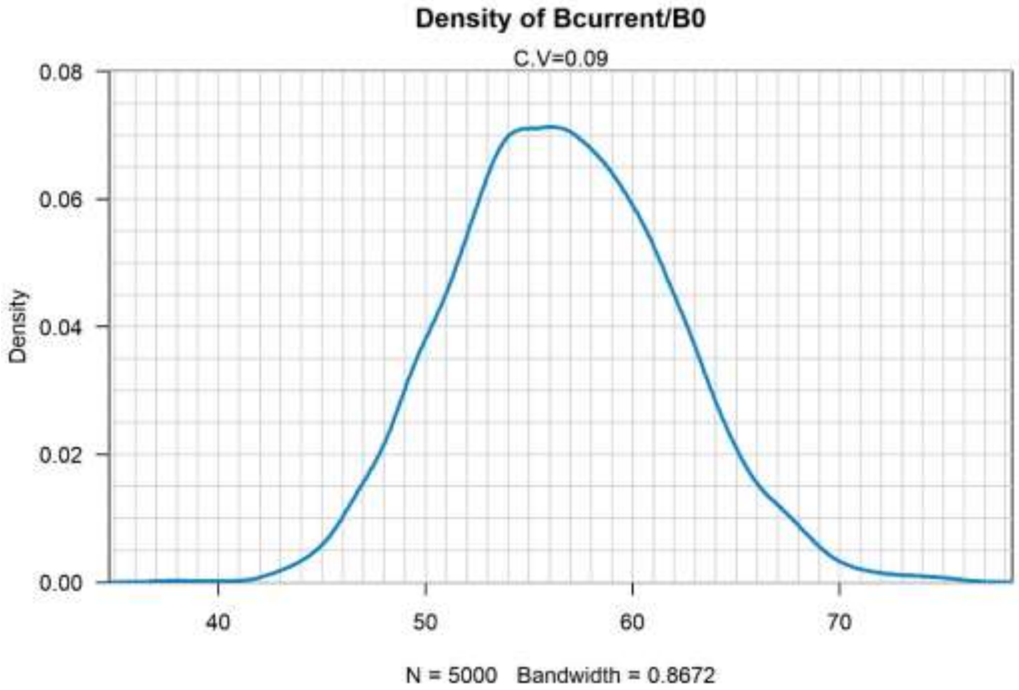
Base case run (1g)

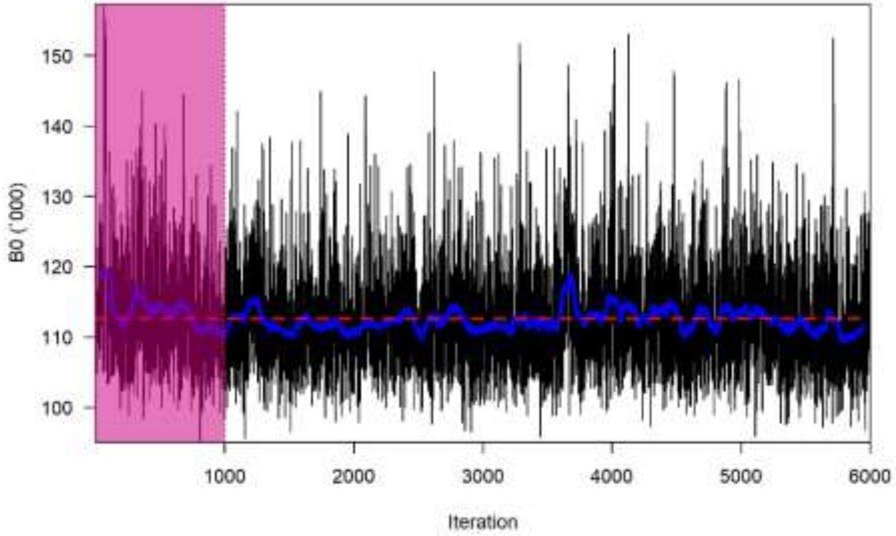


Base case run (1g)

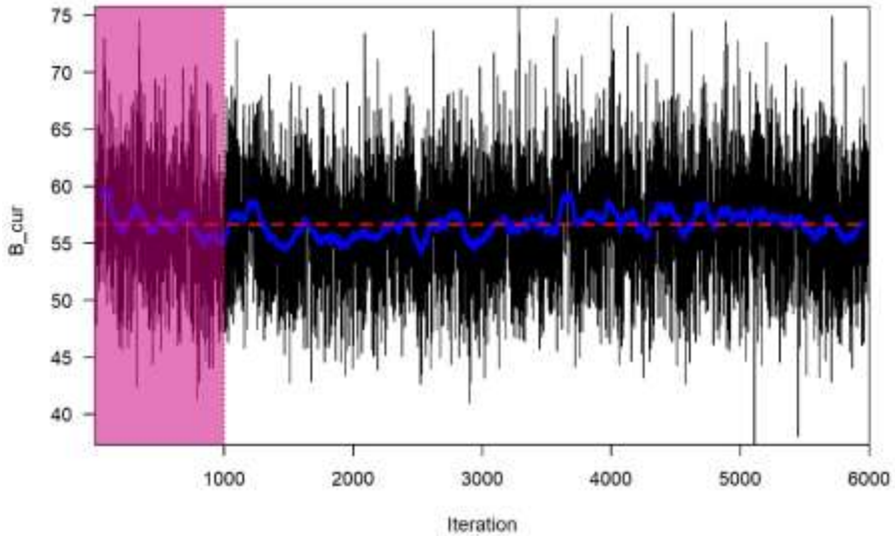
$B_{current}(\%B_0)$ estimated at 56.5% (48.2%, 65.5%); c.v. 9.3%







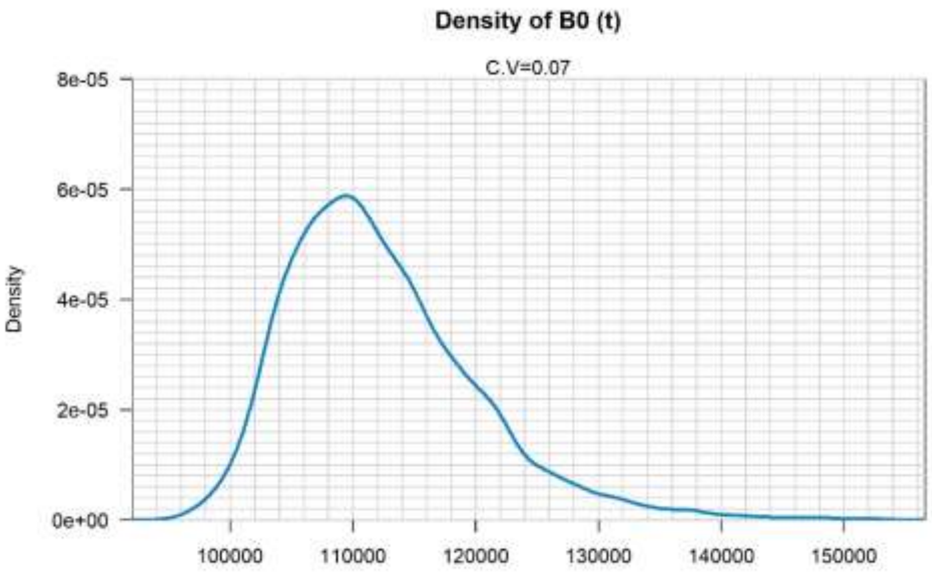
excluded

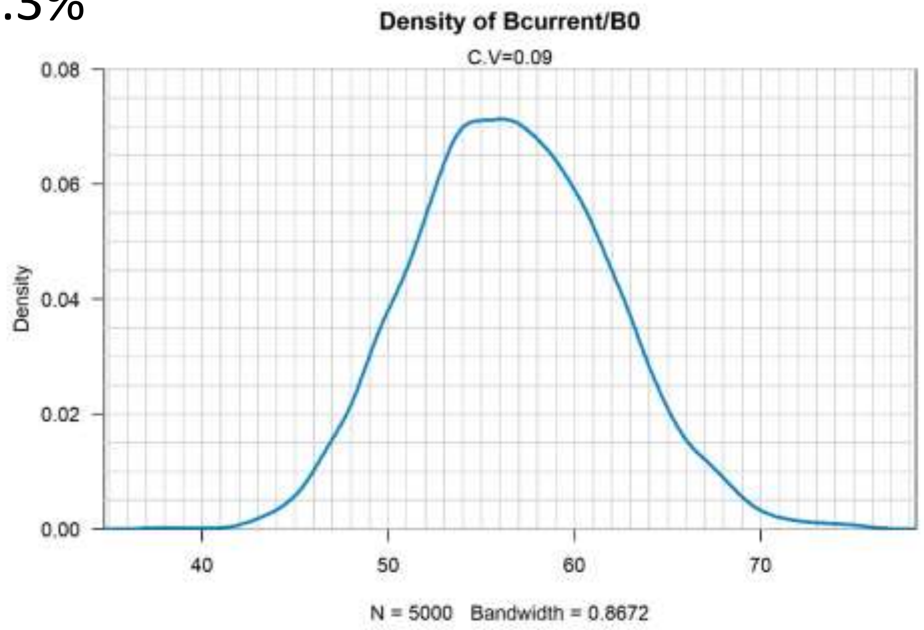


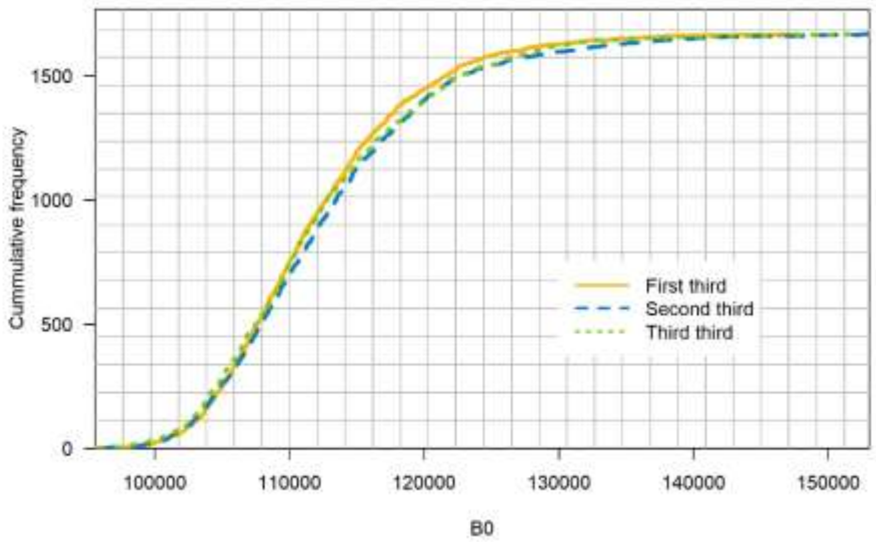
Base case run (1g)

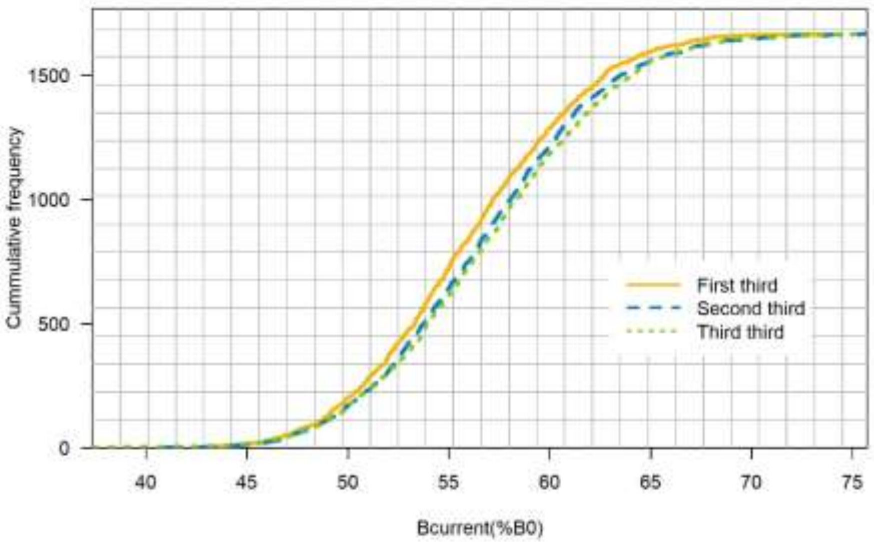
$B_{current}(\%B_0)$ estimated at 56.5% (48.2%, 65.5%)

c.v. 9.3%

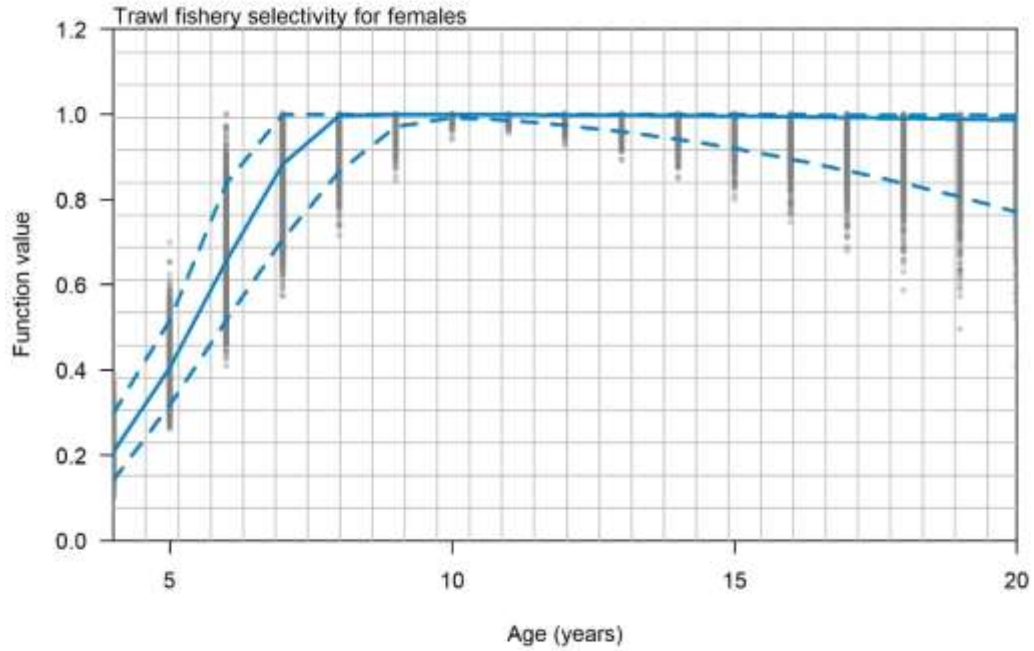


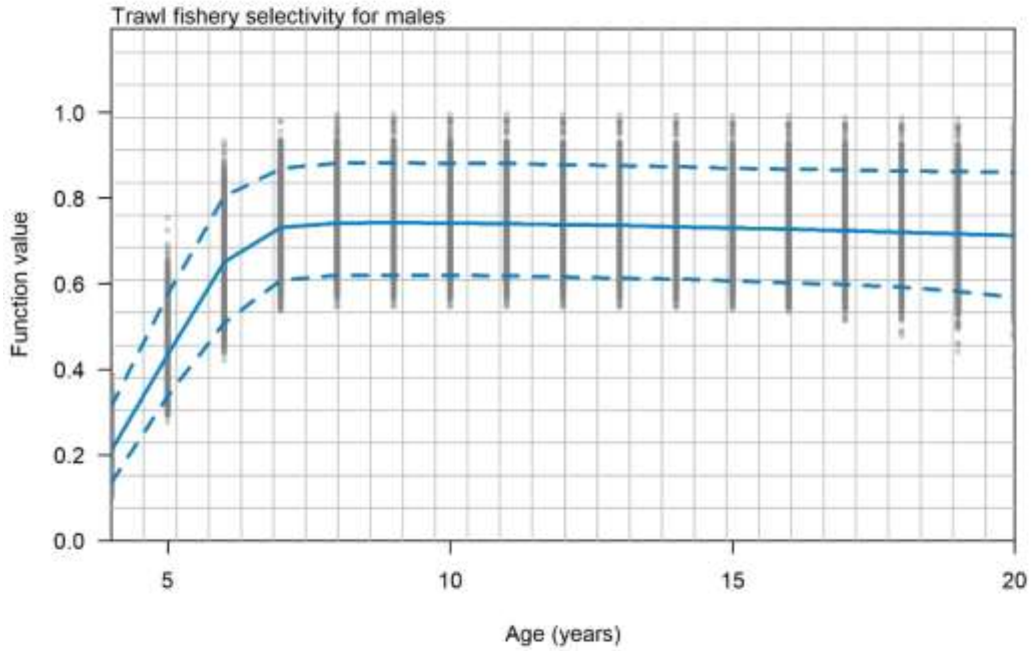


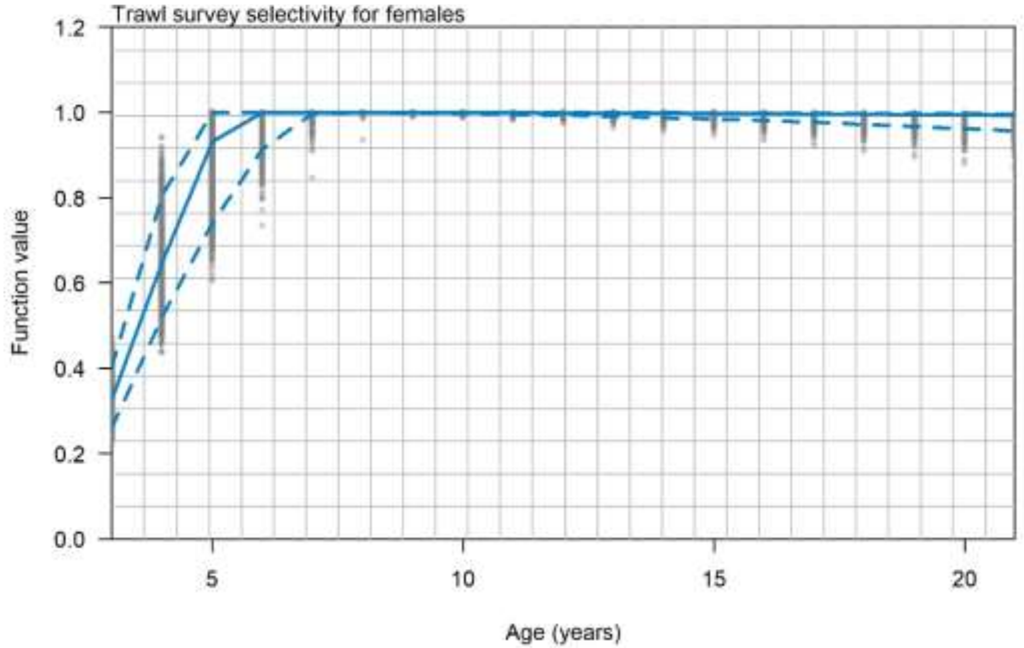


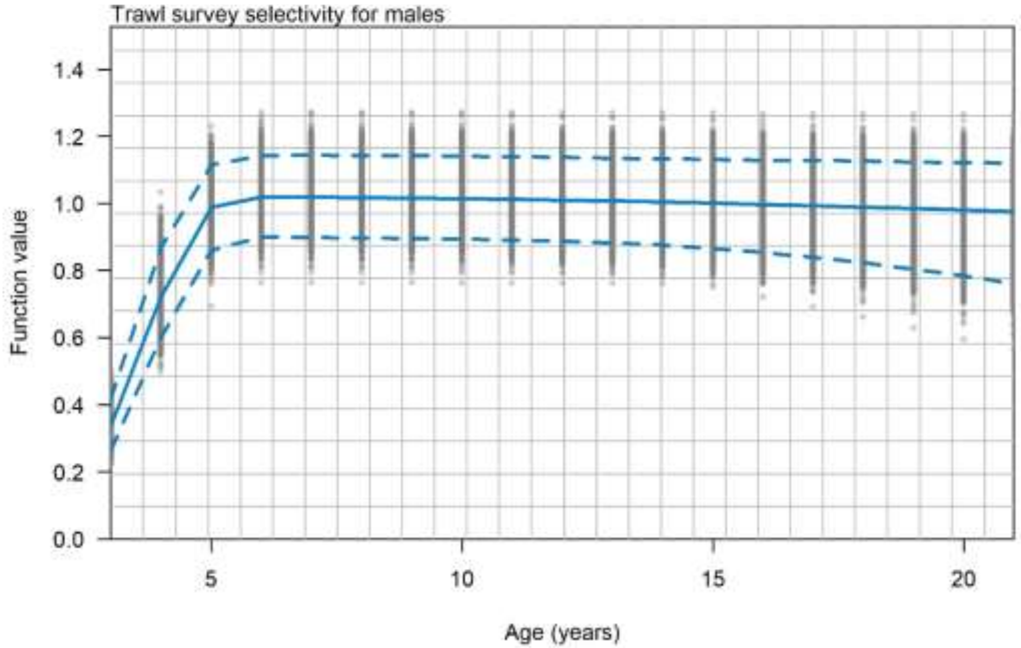


Base case run (1g)



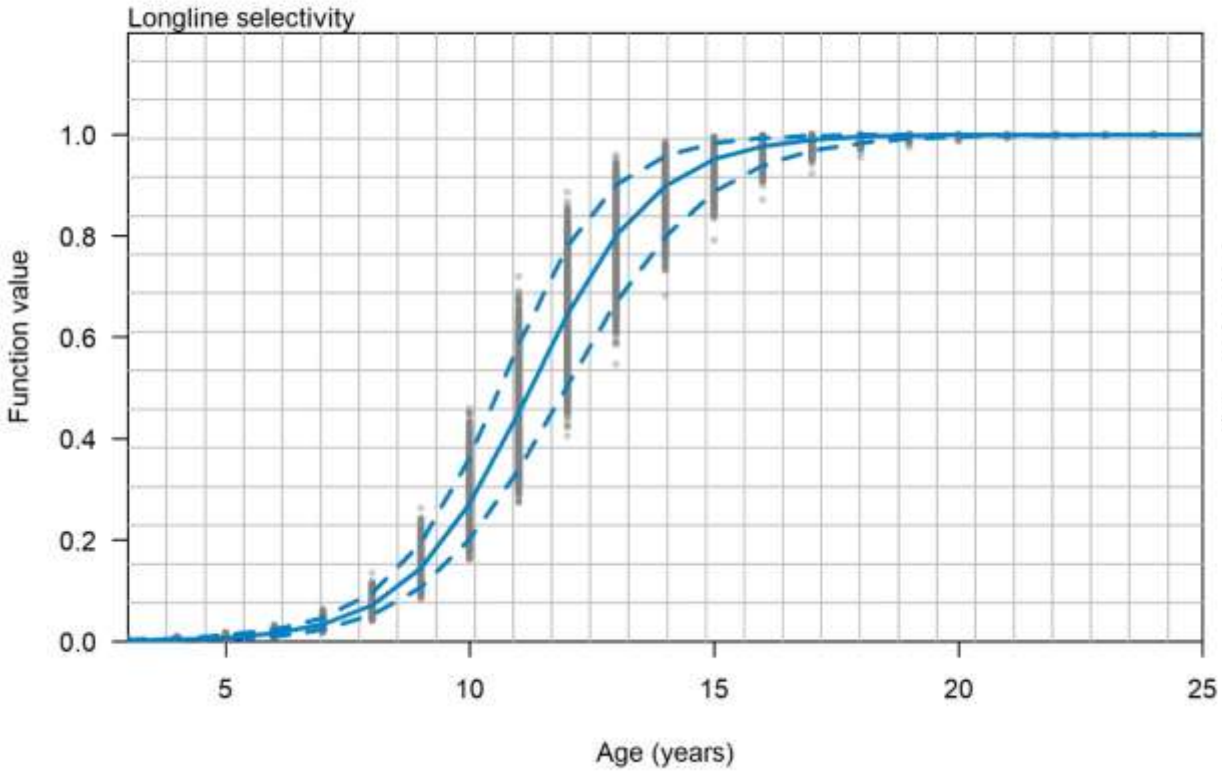




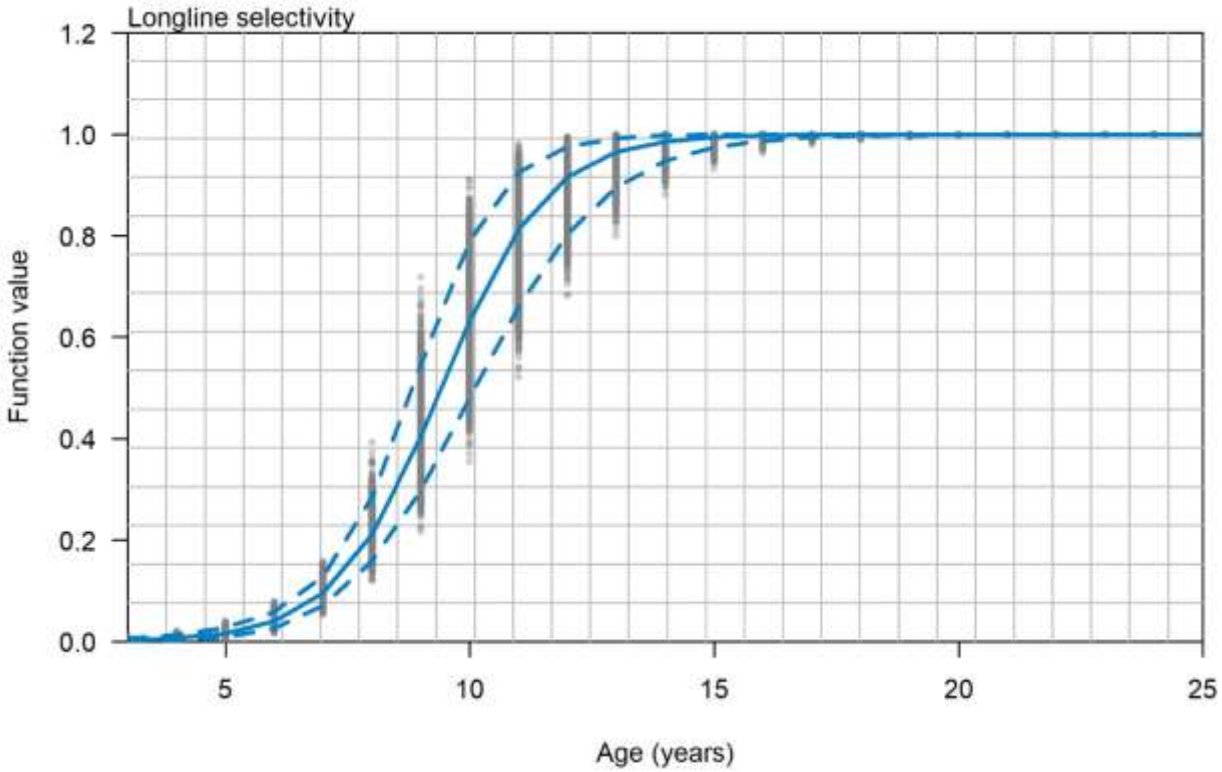


Base case run (1g)

Female

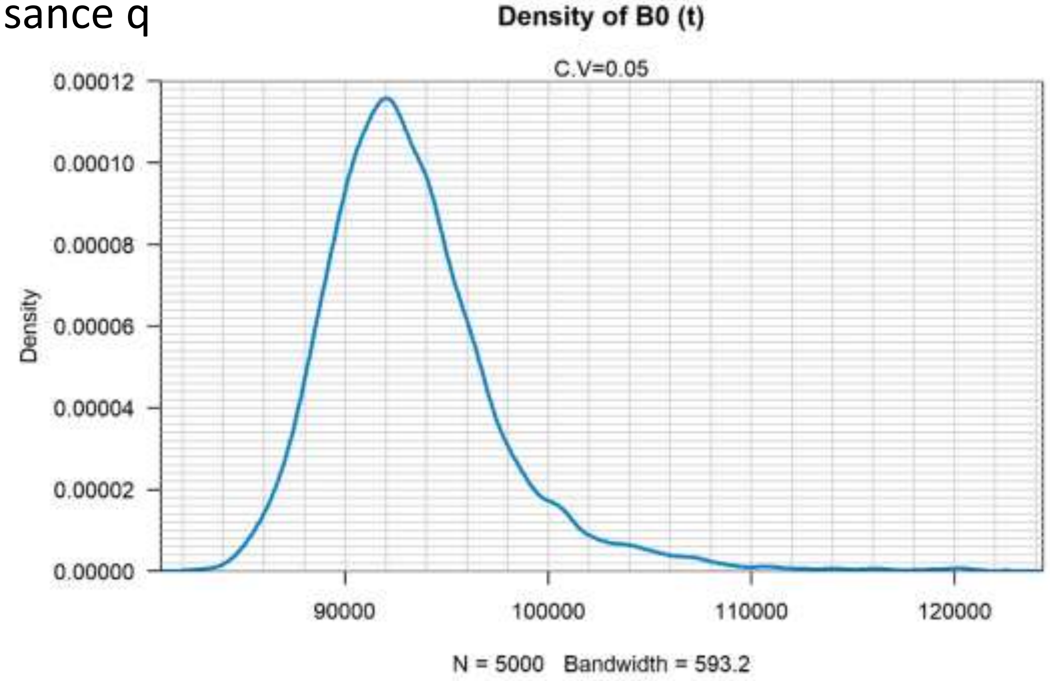


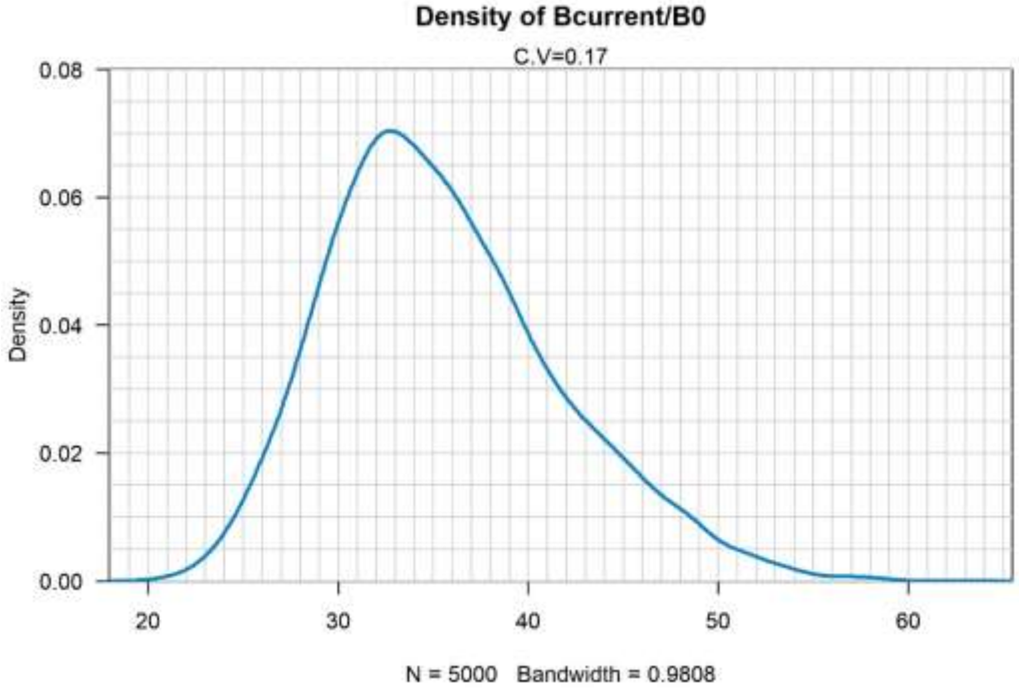
Male

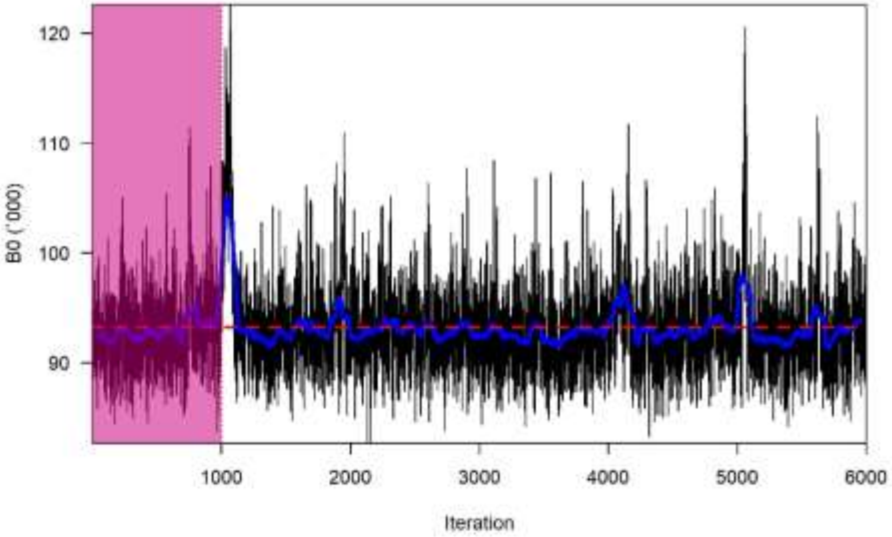


Run 2 (2f)
Nuisance q

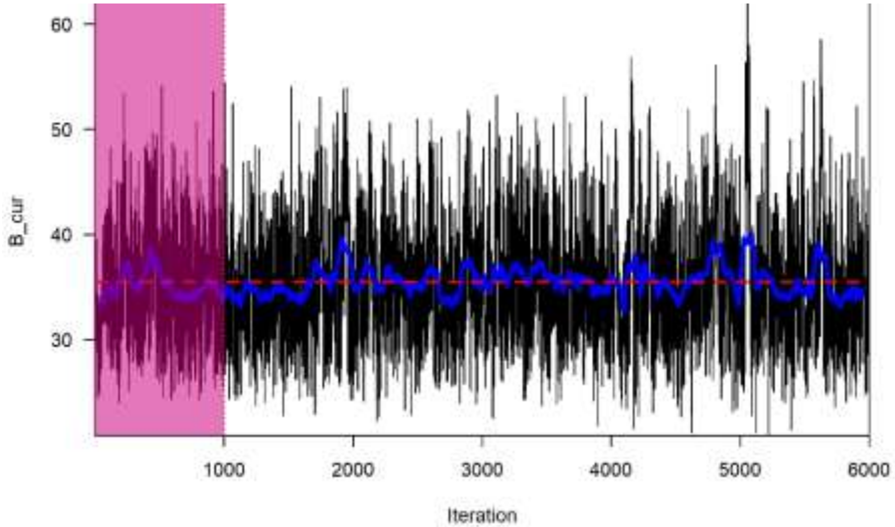
$B_{current}$(%B_0) estimated at 34.8% (26.8%, 46.9%); c.v. 17.1%



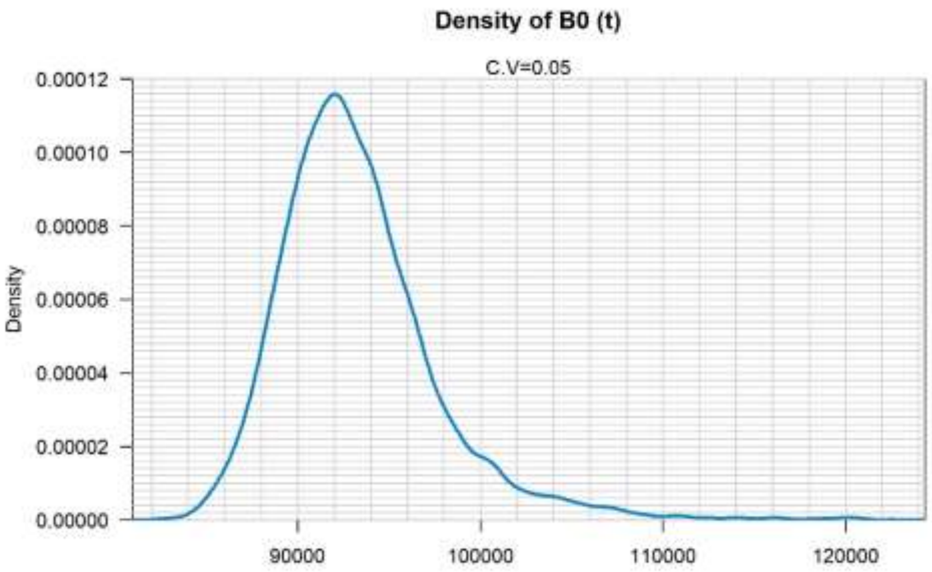


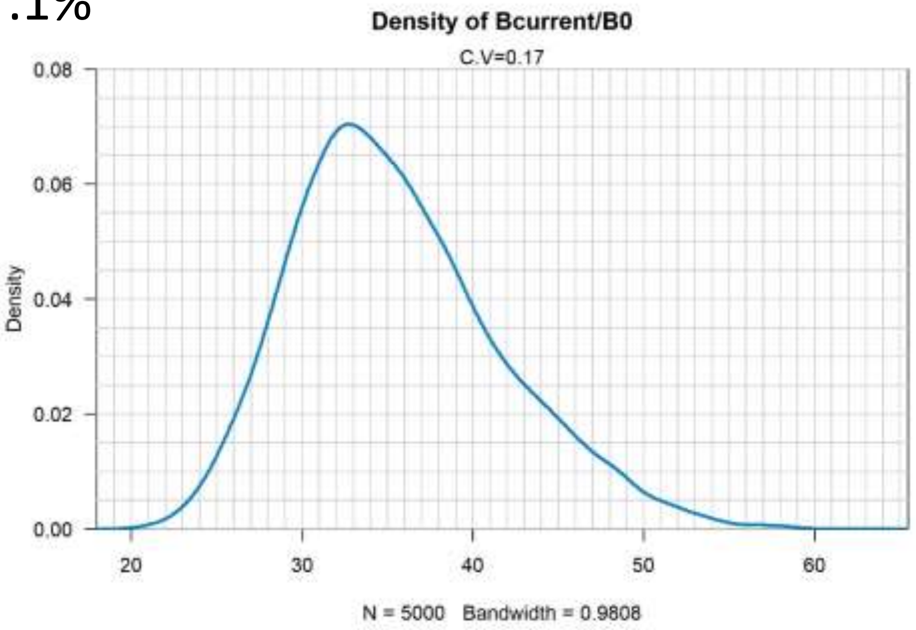


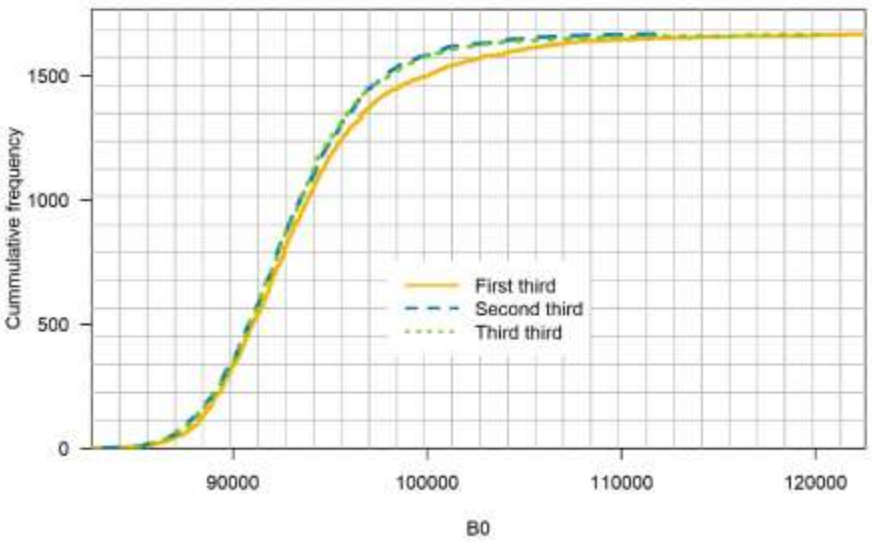
excluded

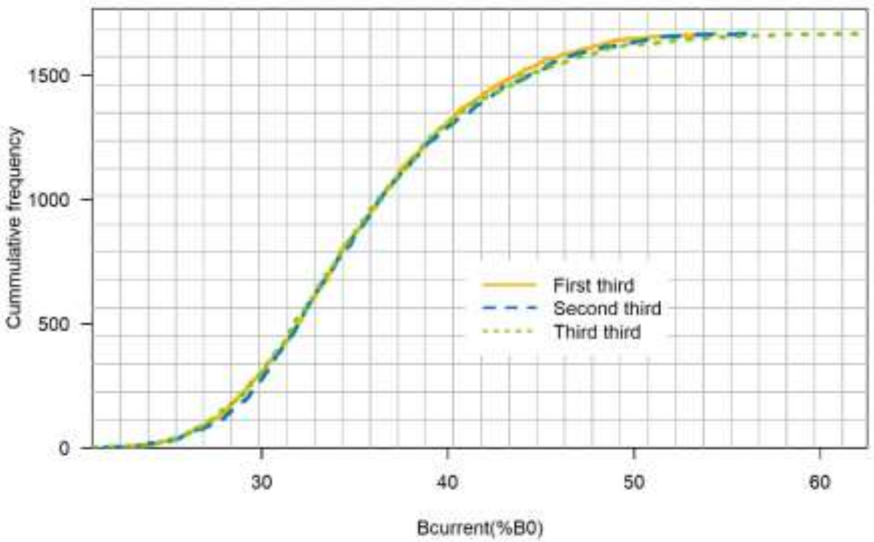


$B_{current}(\%B_0)$ estimated at 34.8% (26.8%, 46.9%) c.v. 17.1%

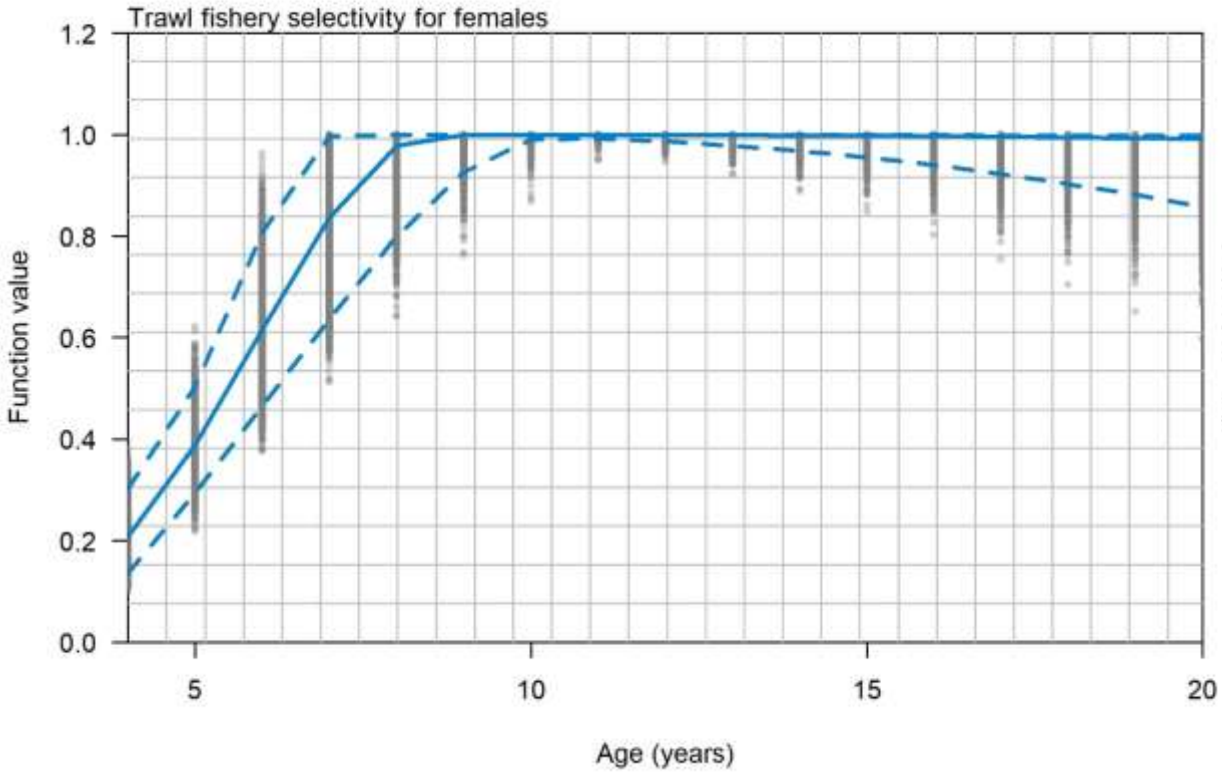




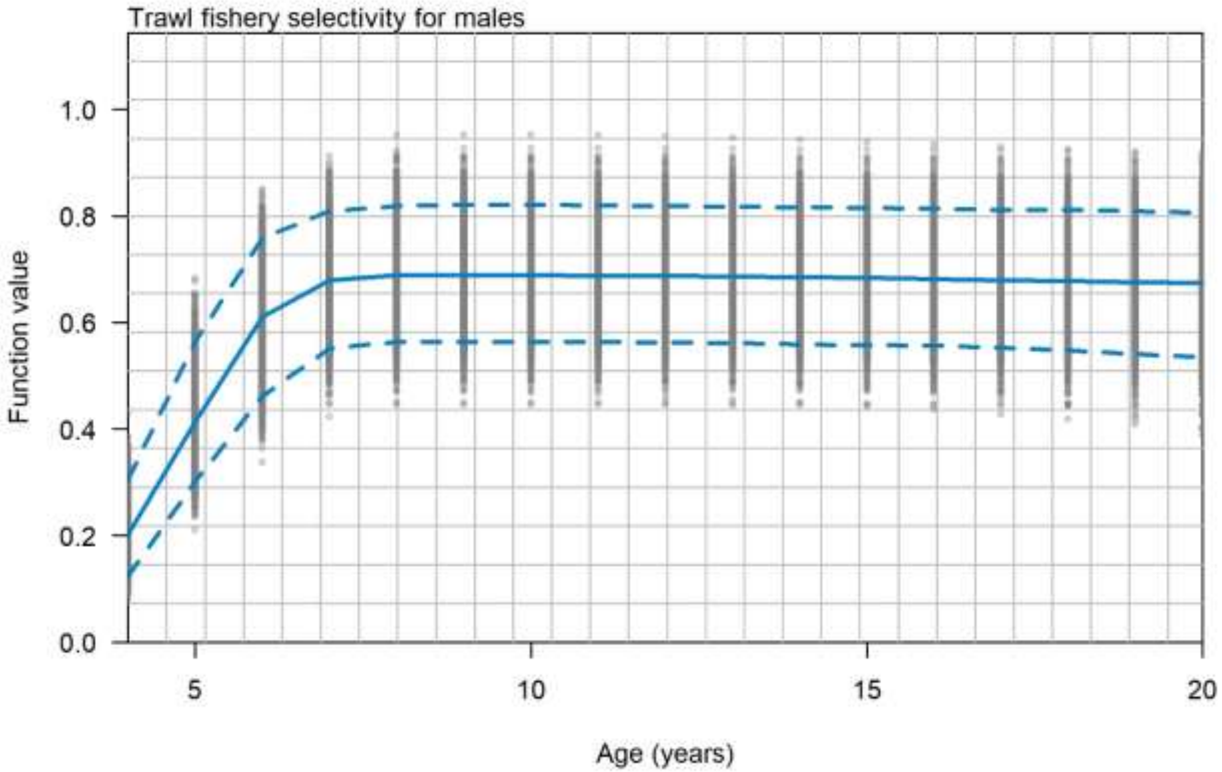




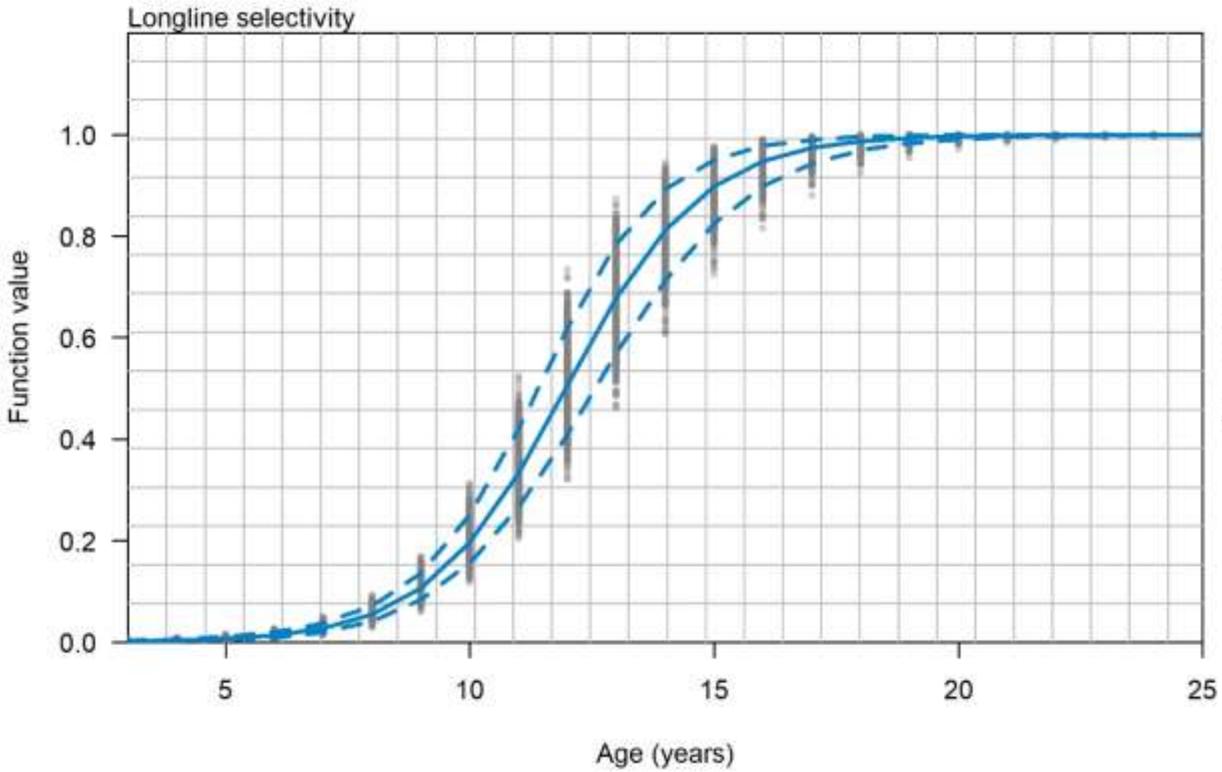
Female


Trawl fishery selectivity for females
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Function value
5
10
15
20
Age (years)

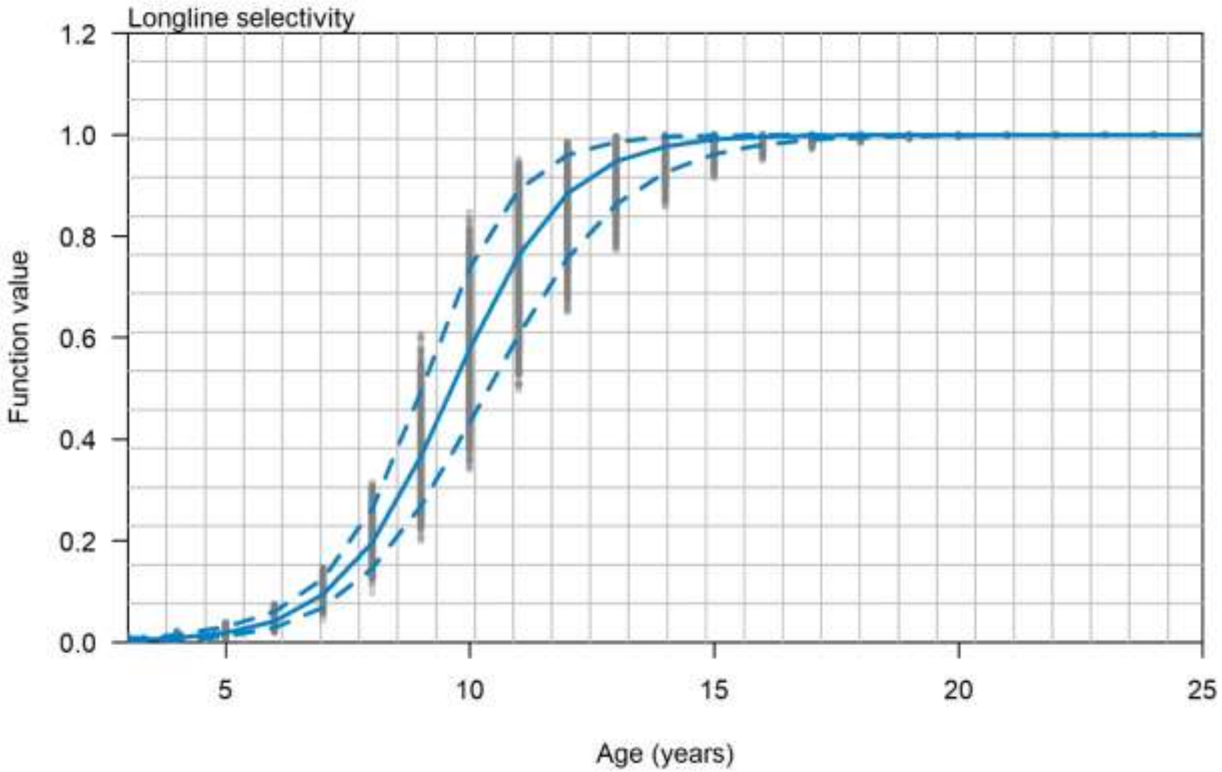
Male


Trawl fishery selectivity for males
1.0
0.8
0.6
0.4
0.2
0.0
Function value
5
10
15
20
Age (years)

Female


Longline selectivity
Function value
Age (years)
0.0
0.2
0.4
0.6
0.8
1.0
5
10
15
20
25

Male


Longline selectivity
Function value
Age (years)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
5
10
15
20
25

95% credible intervals (in parentheses)

Model run	**B_0**	**B_{2019}**	**B_{2019} (% B_0)**	**P(40% B_0)**
Base (run 1g)	111 067 (102 260 - 126 828)	62 800 (49 641 – 82 913)	56.5 (48.2 – 65.5)	0.001
CPUE (run 2f)	92 630 (87 605 - 100 986)	32 075 (24 627 – 46 258)	34.8 (26.8 – 46.9)	0.782

	Total catch (t)	Longline catch (t)	Trawl catch (t)
Average last 5 years	3883	2520	1363
TACC (split as for av. catches)	6260	4063	2197

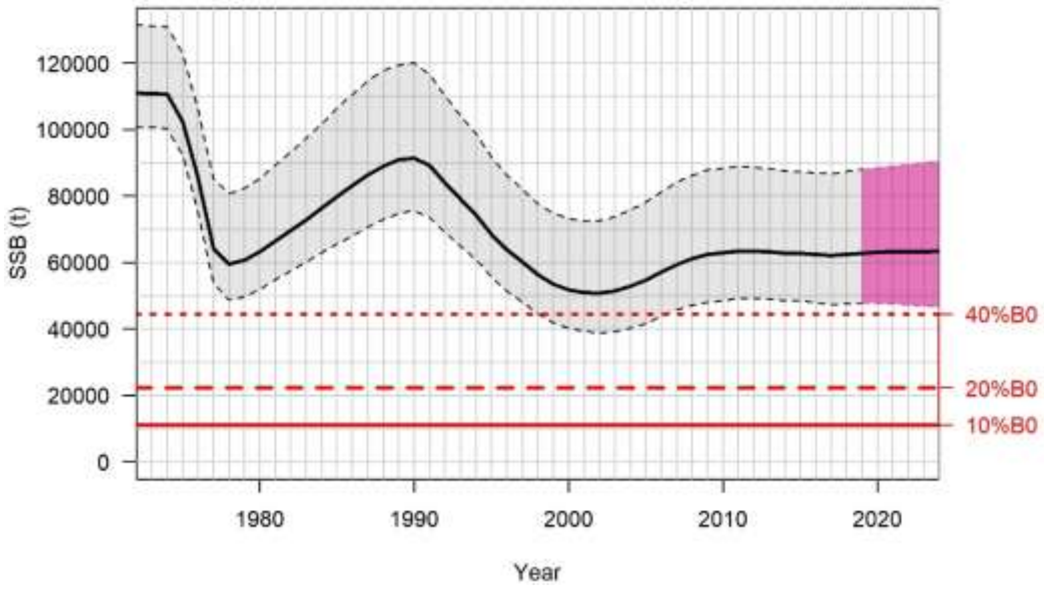
..

Relative year class strengths from 2020 onwards were selected in two ways

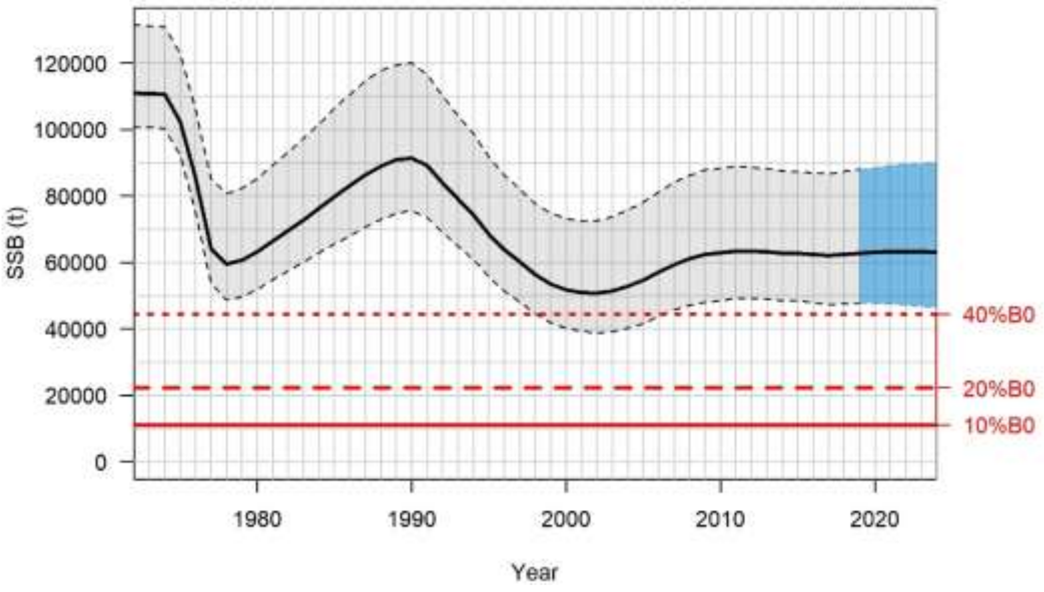
1. The randomised YCS were resampled using all estimated YCS.
2. The randomised YCS were resampled using the most recent 10 estimated YCS.

Base case run (1g)

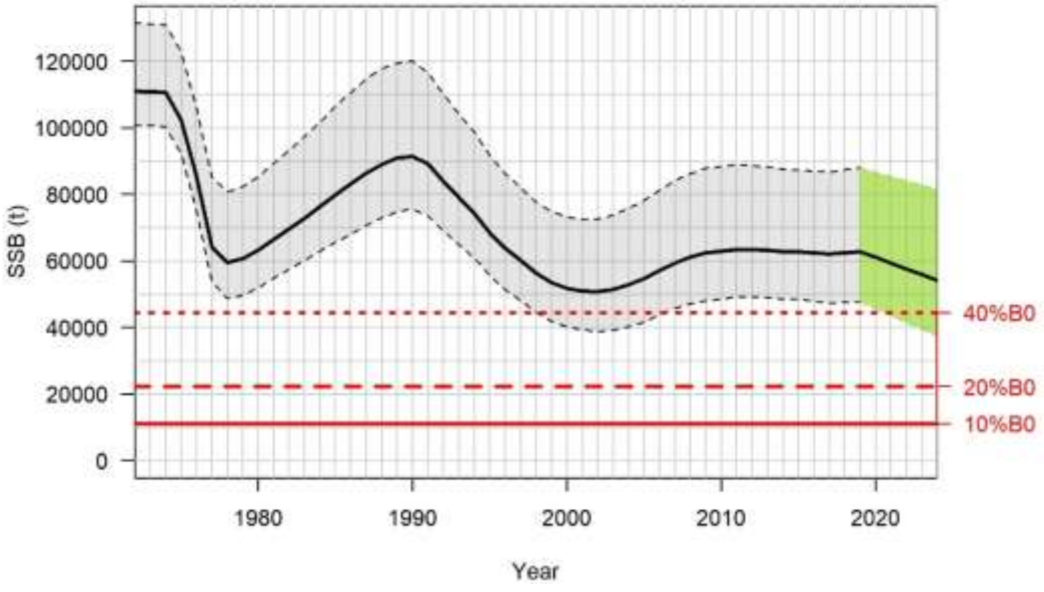
Recent catch; all YCS



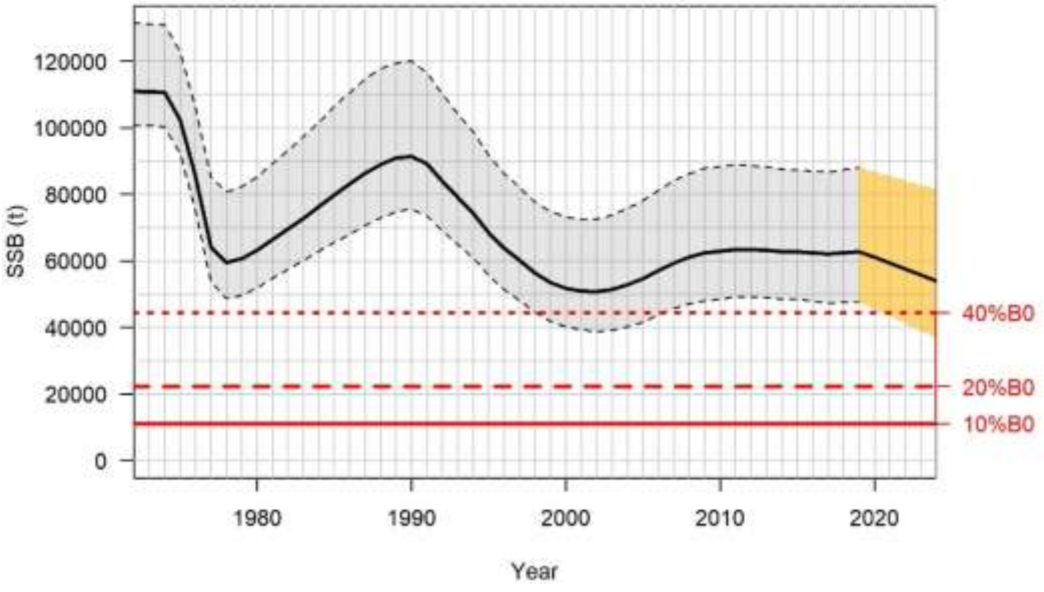
Recent catch; last 10 YCS



TACC; all YCS

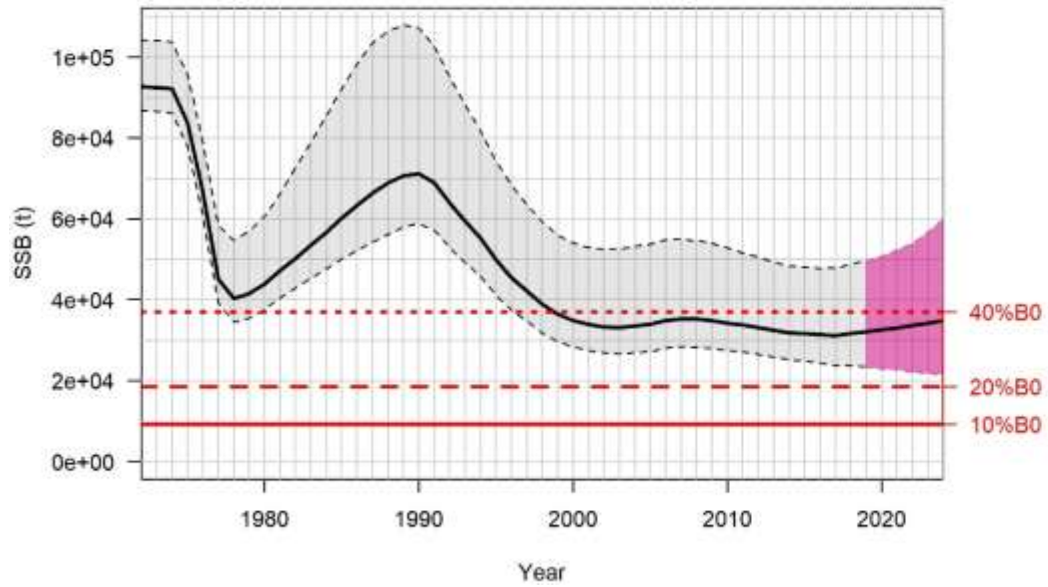


TACC; last 10 YCS

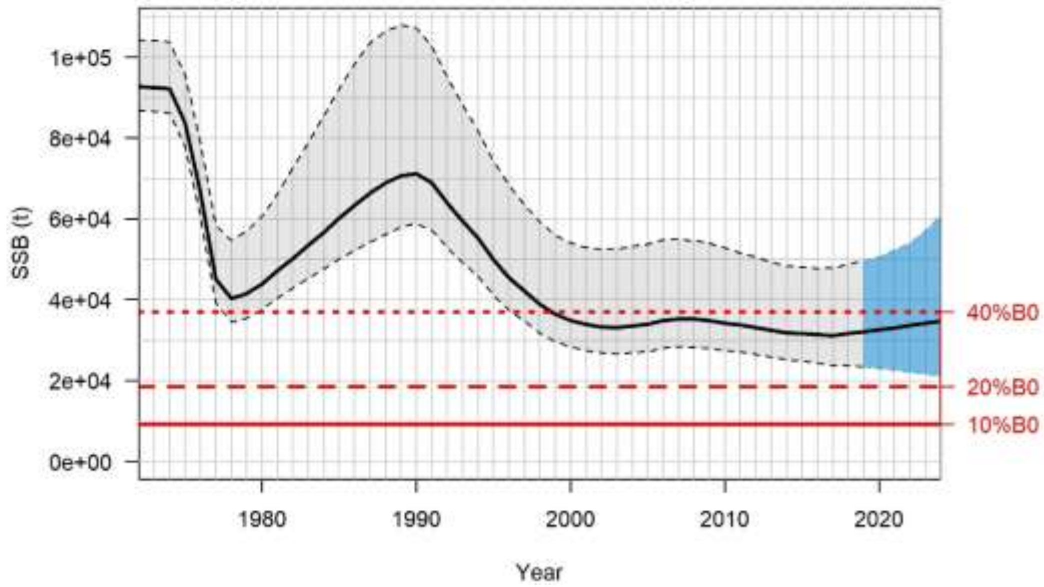


Run 2 (2f)
Nuisance q

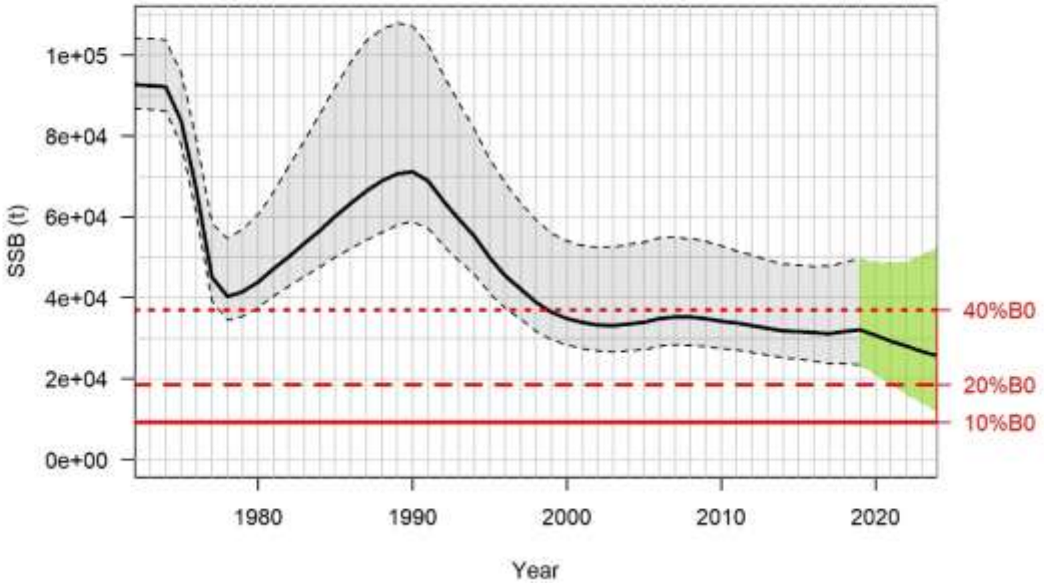
Recent catch; all YCS



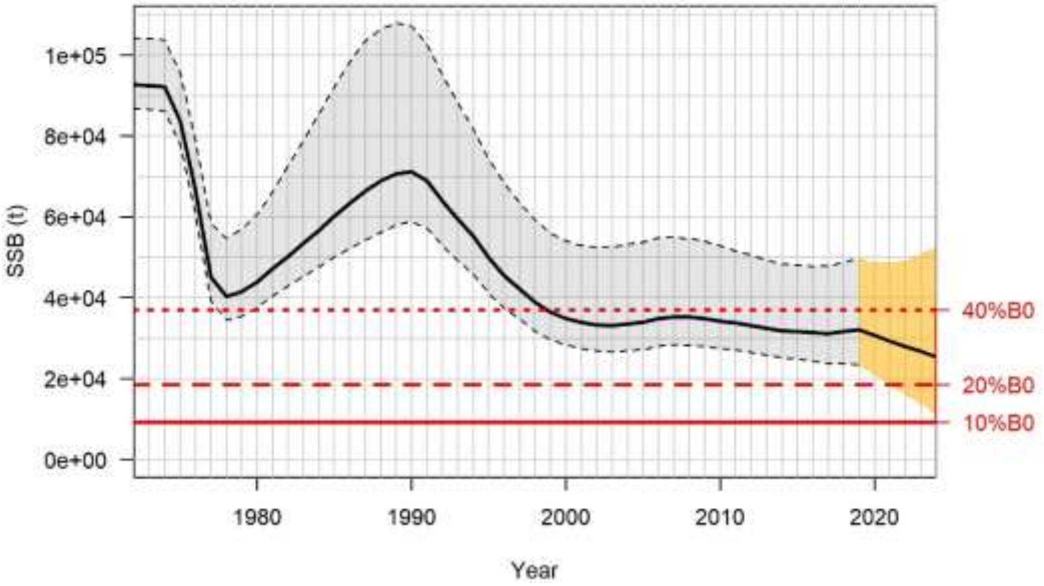
Recent catch; last 10 YCS



TACC; all YCS



TACC; last 10 YCS



	Future catch	Future YCS	B_{2024}	B_{2024}(%B_0)	B_{2024}(%B_{2019})
Base Run	Average last 5 years	All estimated YCS	63 300 (46 600, 90 400)	57 (56, 70)	101 (92, 111)
	Average last 5 years	Last 10 yrs YCS	63 100 (46 400, 90 200)	57 (46, 70)	100 (91, 111)
	TACC (split as for av. catches)	All estimated YCS	54 200 (37 500, 81 500)	49 (37, 63)	86 (75, 98)
	TACC (split as for av. catches)	Last 10 yrs YCS	54 000 (37 000, 81 600)	49 (36, 63)	86 (75, 98)
Longline Run	Average last 5 years	All estimated YCS	34 800 (21 400, 59 800)	38 (24, 58)	106 (85, 145)
	Average last 5 years	Last 10 yrs YCS	34 700 (21 100, 60 700)	38 (23, 59)	106 (83, 146)
	TACC (split as for av. catches)	All estimated YCS	25 700 (12 100, 52 200)	28 (13, 50)	79 (49, 121)
	TACC (split as for av. catches)	Last 10 yrs YCS	25 400 (11 400, 52 600)	28 (13, 51)	78 (46, 126)

Base case run (1g)

'Current' year	Future catch	Future YCS	$P(B_{current}<40\%B_0)$	$P(B_{current}<20\%B_0)$	$P(B_{current}<10\%B_0)$
2019	-		0.001	0.0	0.0
2024	TACC (split as for av. catches)	All estimated YCS	0.08	0.0	0.0
2024	TACC (split as for av. catches)	Last 10 yrs YCS	0.08	0.0	0.0
2024	Average last 5 years	All estimated YCS	0.001	0.0	0.0
2024	Average last 5 years	Last 10 yrs YCS	0.001	0.0	0.0

Thank you

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