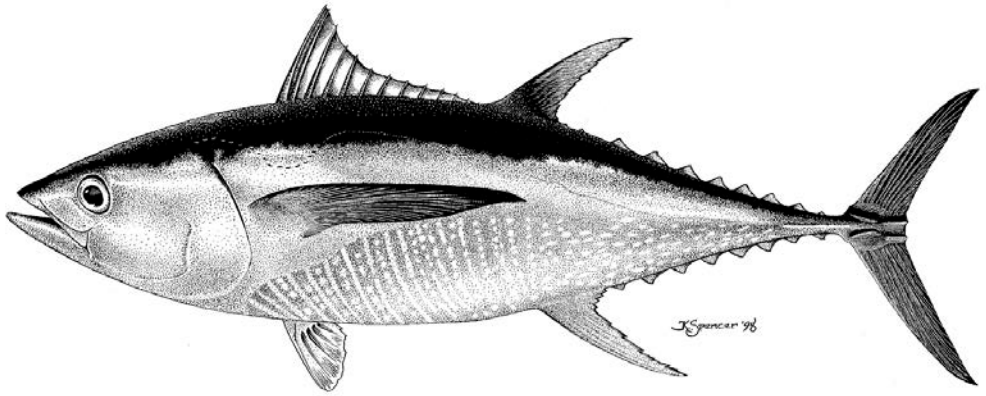
An exploration of alternative methods to deal with time-varying selectivity in the YFT stock assessment (Doc YFT-01-06)

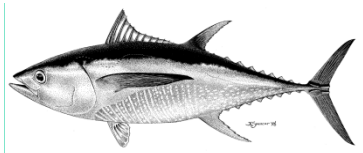
Alexandre Aires-da-Silva and Mark Maunder

External review of IATTC yellowfin tuna assessment

La Jolla, USA, 15-19 October, 2012

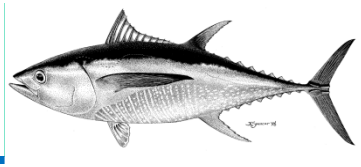


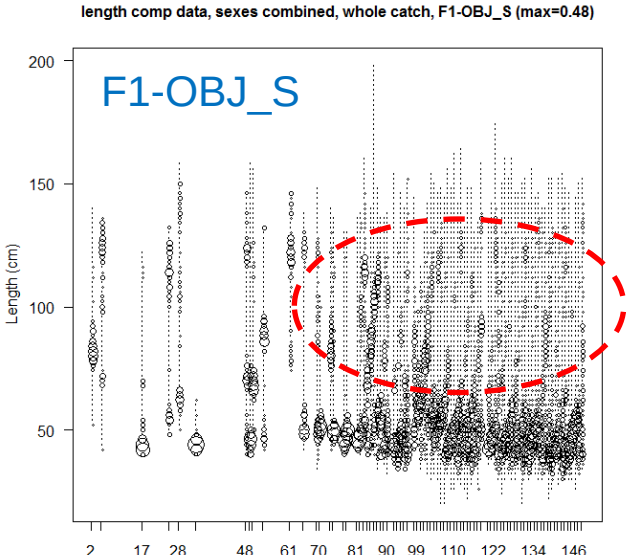
Outline

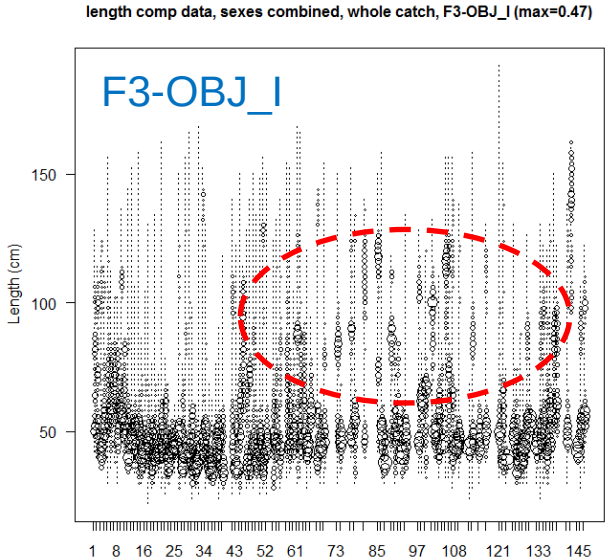


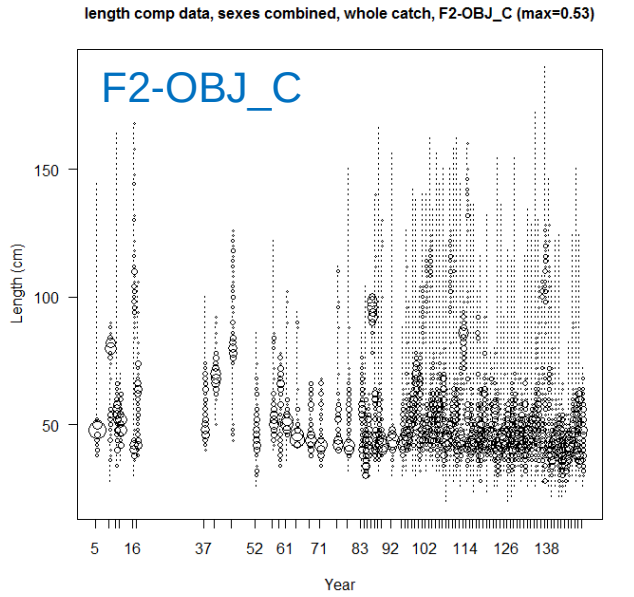
- Selectivity issues in the YFT assessment
  - Time-varying
- Explore SS3 approaches to deal with time-varying selectivity
  - Ignore time-varying selectivity
  - Full time-varying selectivity (quarterly deviates)
  - Full time-varying for terminal years only
  - Time blocks of time-varying selectivity

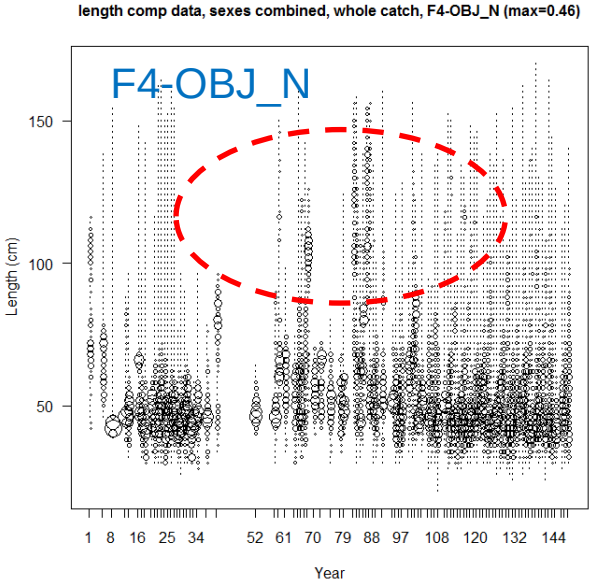
OBJ time-varying selectivity?











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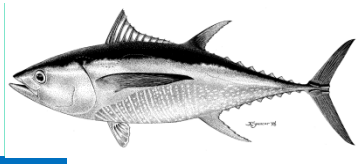
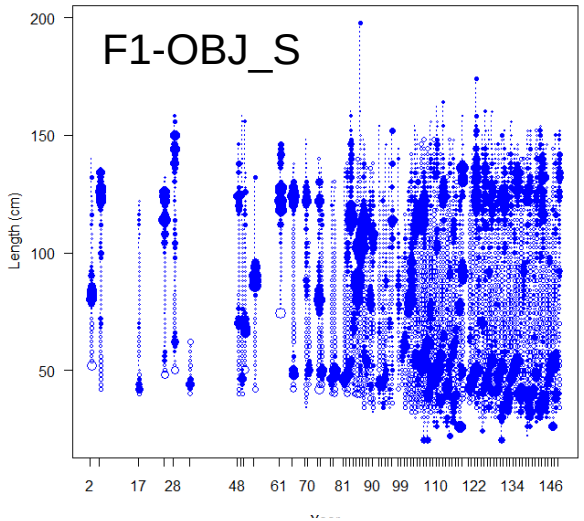
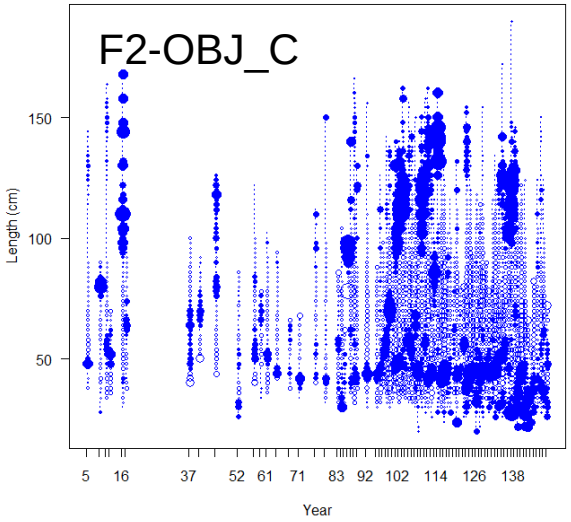
OBJ size comp. residual pattern



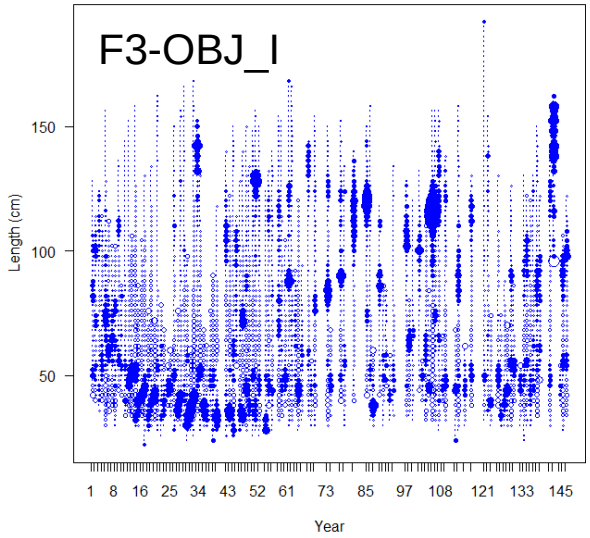
Pearson residuals, sexes combined, whole catch, F1-OBJ_S (max=5.2)



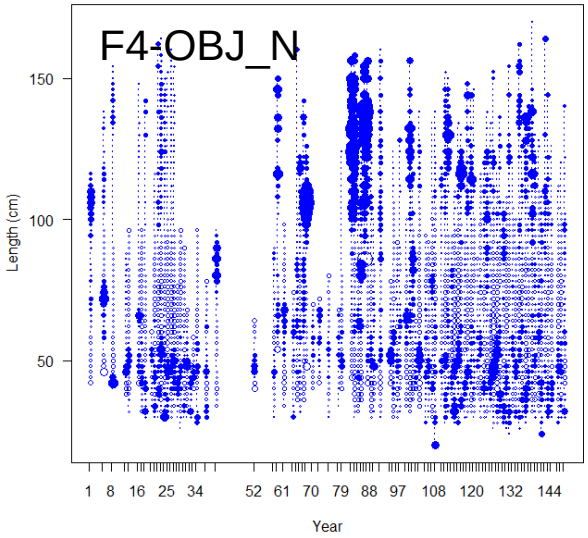
Pearson residuals, sexes combined, whole catch, F2-OBJ_C (max=5.46)

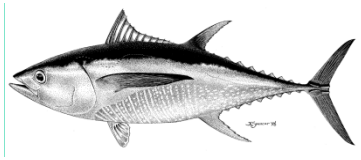


Pearson residuals, sexes combined, whole catch, F3-OBJ_I (max=12.18)



Pearson residuals, sexes combined, whole catch, F4-OBJ_N (max=7.61)

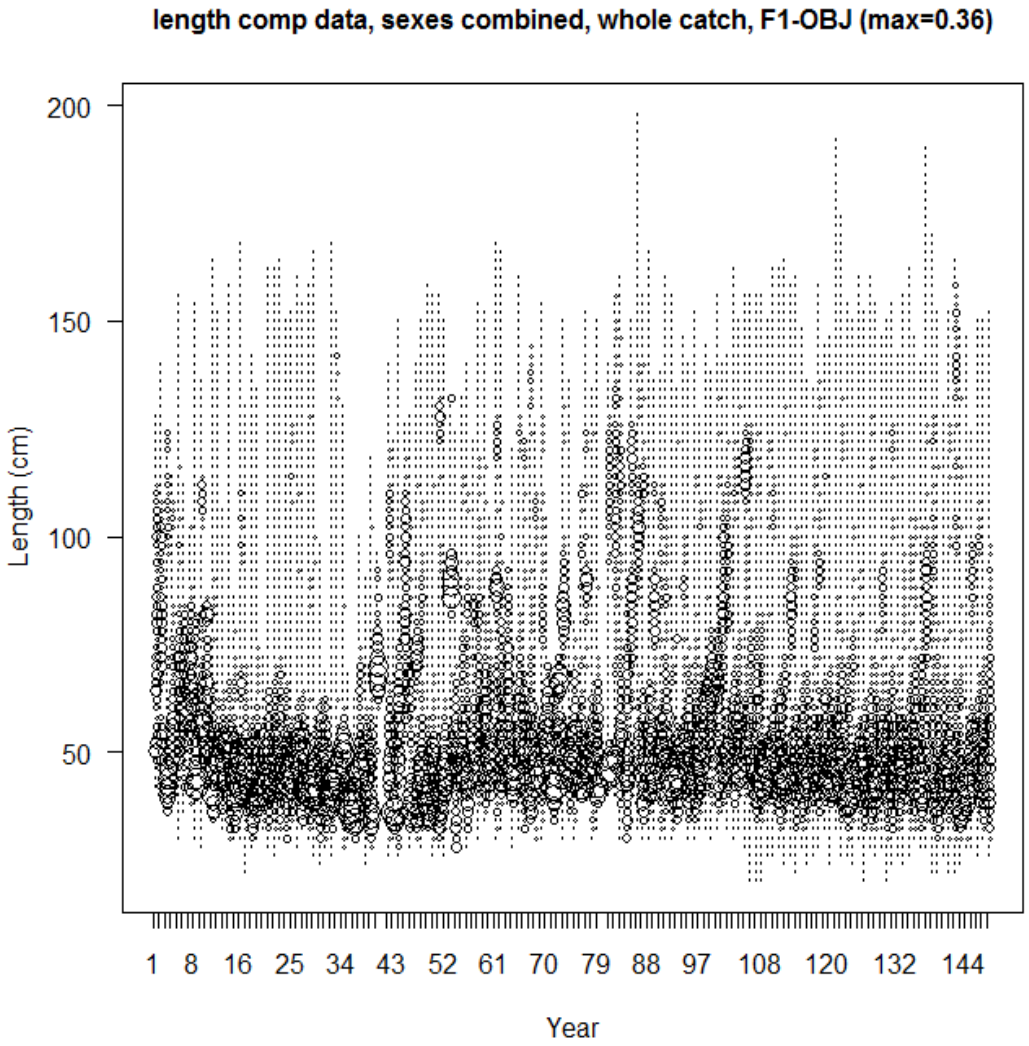




Numerical and convergence issues

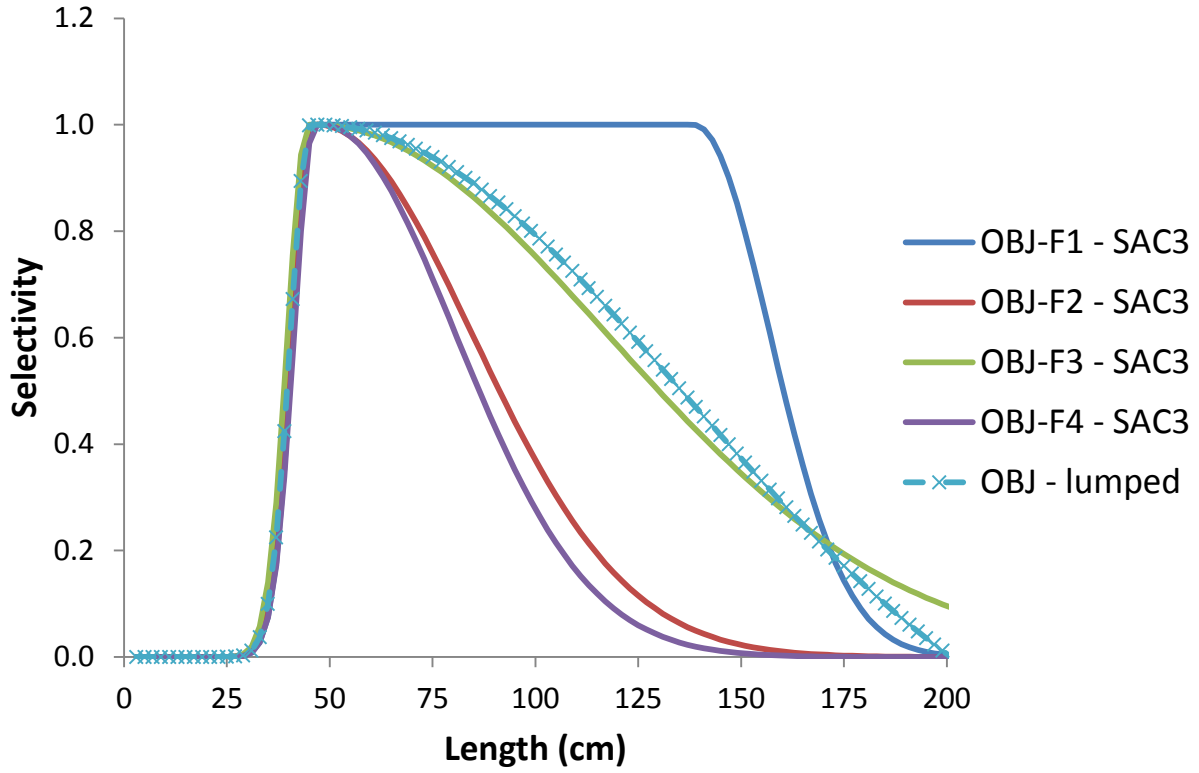
- Unstable selectivites (OBJ)
  - Sensitive to initial parameter values and phases
  - Long run times (> 4 hours)
  - Issues inverting hessian matrix (steepness run)
- Faster and better convergence with R_0 estimated at later phase (may or not be related to selectivity)

A single “lumped” OBJ fishery

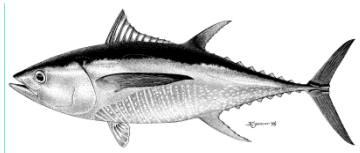


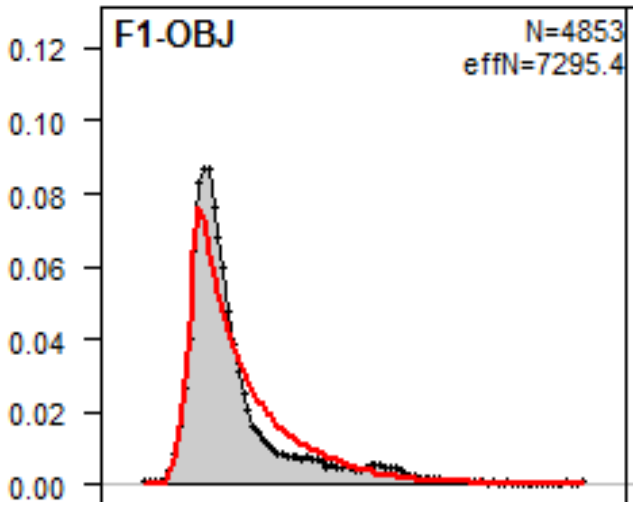
Model 0

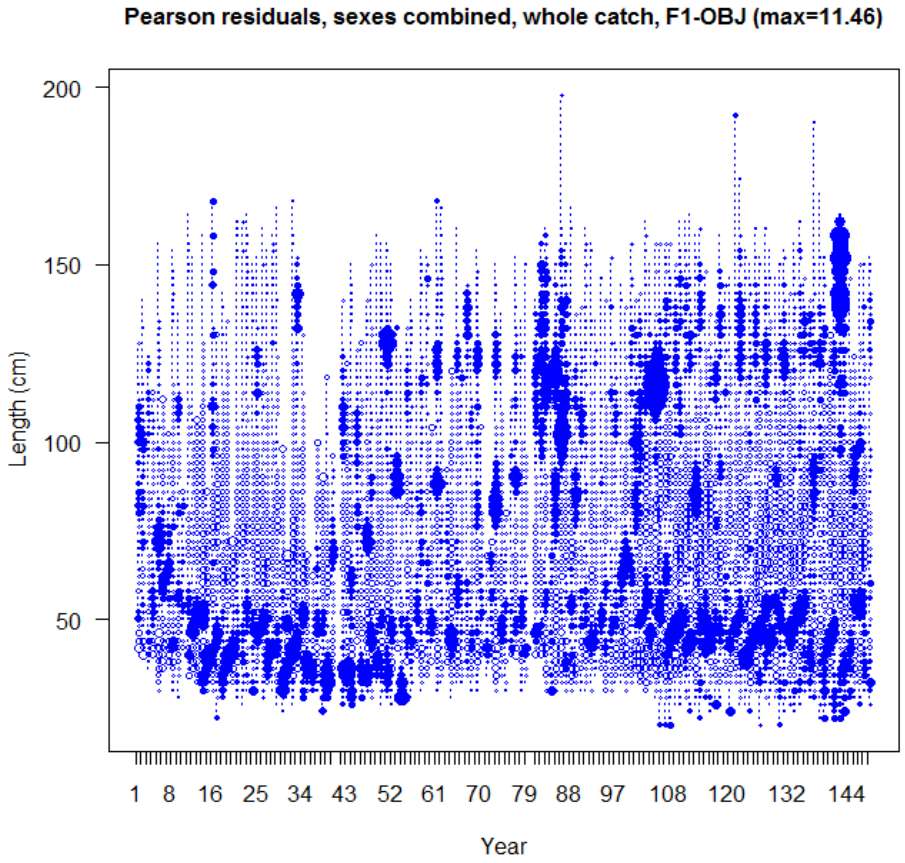
- Estimate “average” stationary selectivity
- Same configuration as in base case model (SAC3)
- Fit to OBJ length-frequency data for all historic period

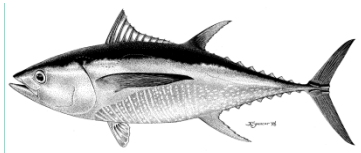


Model type 0




F1-OBJ
N=4853
effN=7295.4
0.12
0.10
0.08
0.06
0.04
0.02
0.00

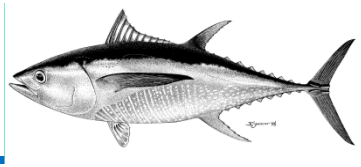

Pearson residuals, sexes combined, whole catch, F1-OBJ (max=11.46)
Length (cm)
200
150
100
50
1 8 16 25 34 43 52 61 70 79 88 97 108 120 132 144
Year

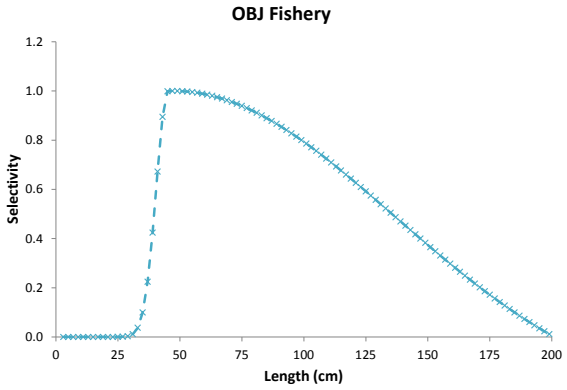


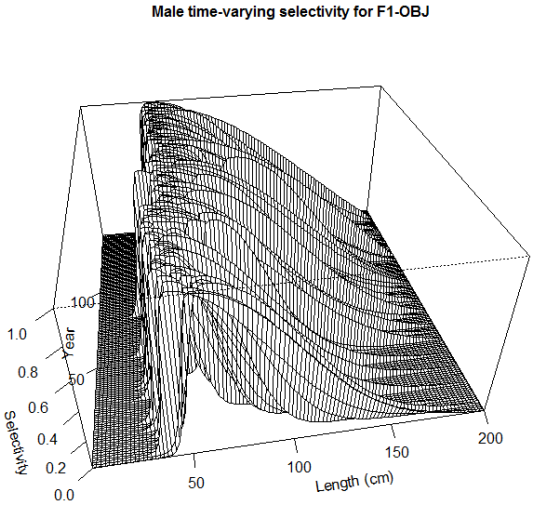
Model type 1

- Full time-varying selectivity process
- Estimate quarterly deviates on base parameters of double normal OBJ selectivity curve
- Fit to OBJ LF data for all historic period
- CVs need to be defined for quarterly deviates
  - Objective criteria: use Grant-Thompson method on first run (CV=1)
  - Fix estimated CVs on a second and final time-varying run

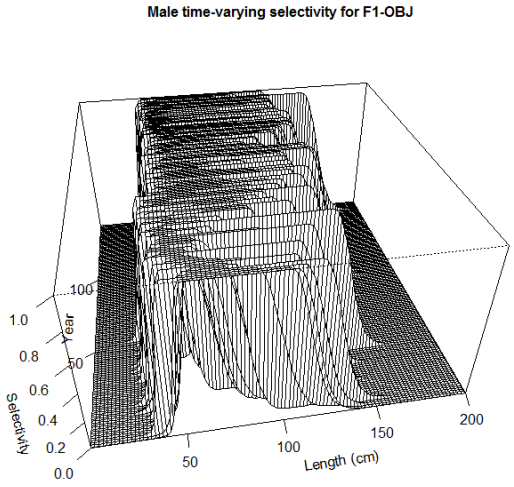
Model type 1







Grant Thompson's method



Paramter	M1-P2fixed	M1-P2est
P1 - peak	0.13	0.14
P2 - top	fixed at -15	1.08
P3 - ascending	0.55	0.51
P4 - descending	1.03	0.41

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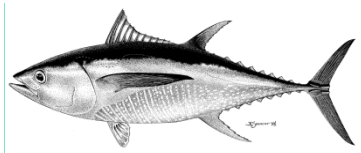
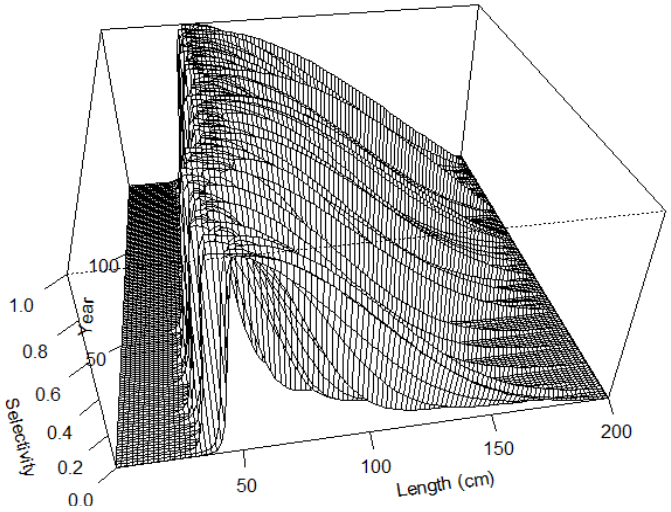
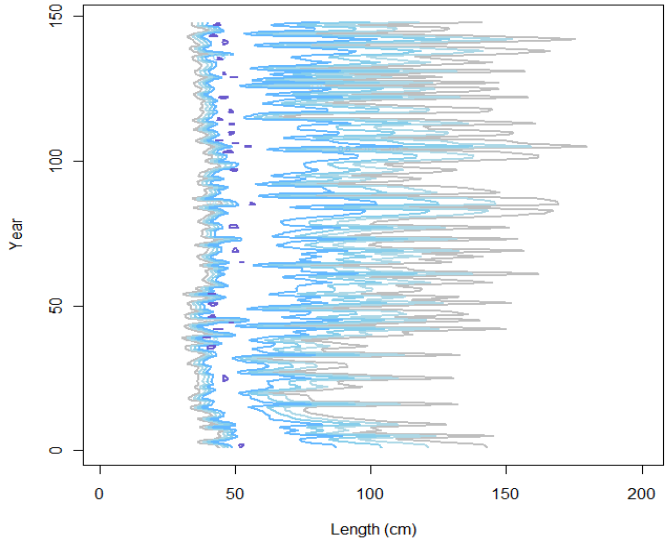
Model type 1

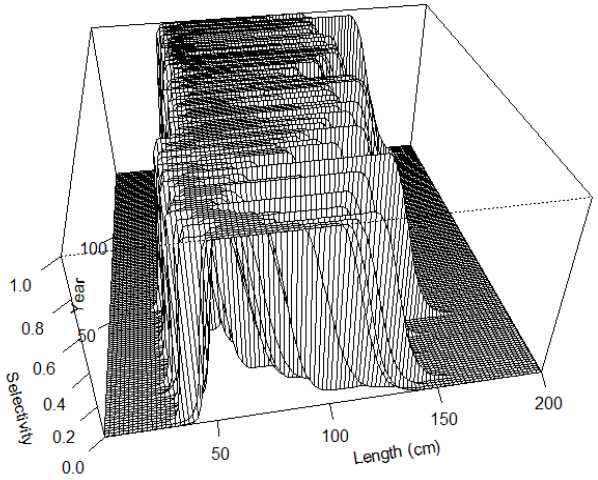


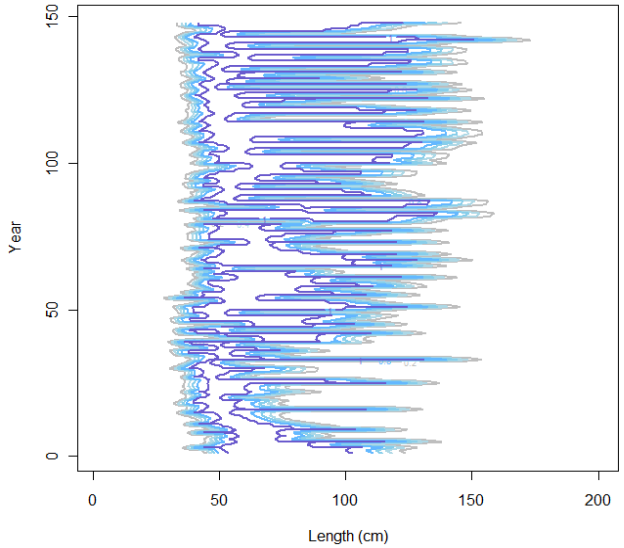
M1-P2fixed





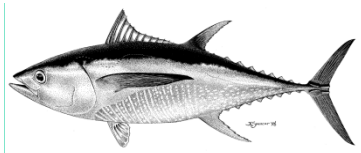
M1-P2est



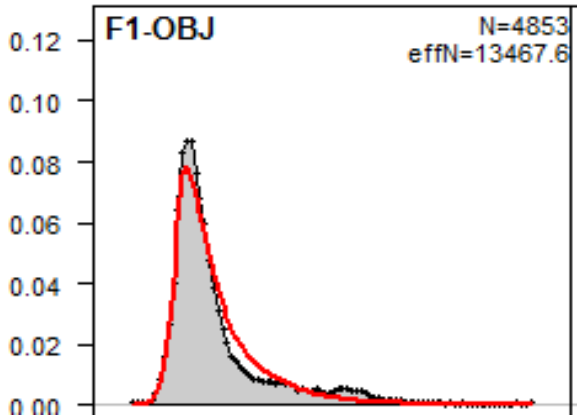


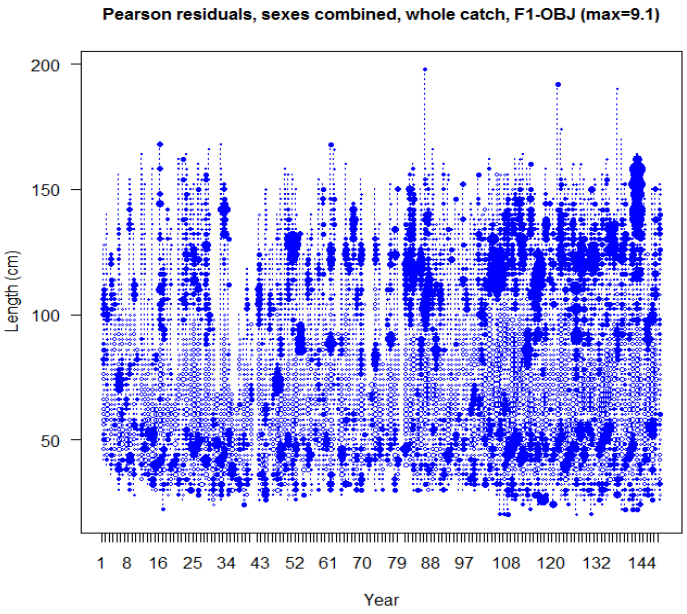
CIAT IATTC

Model type 1

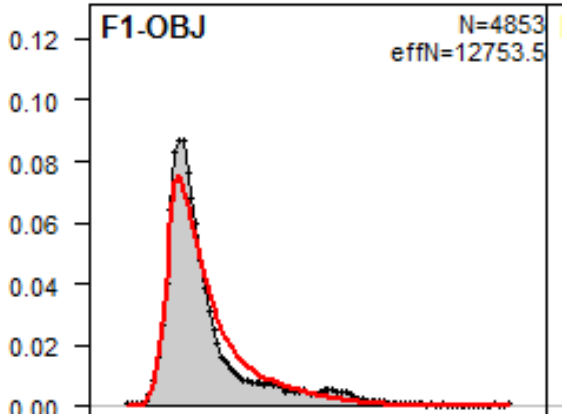


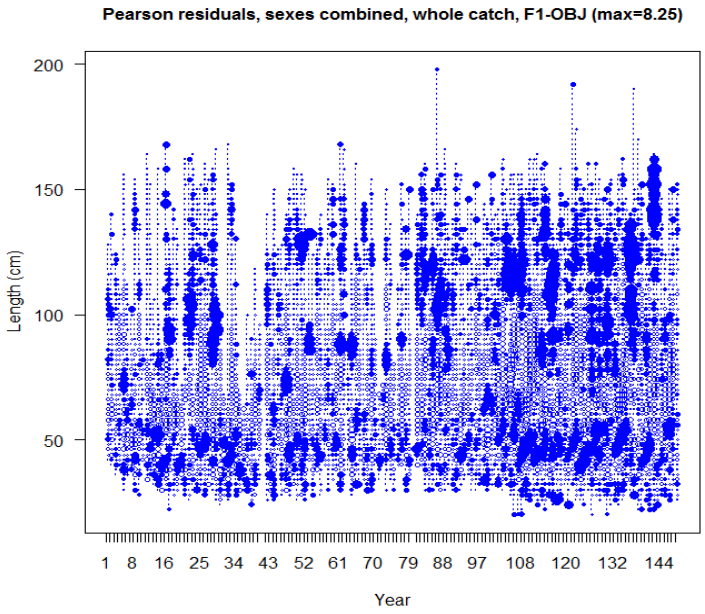
M1-P2fixed





M1-P2est





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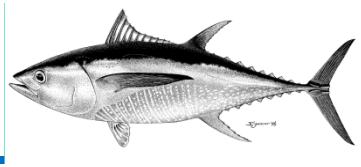
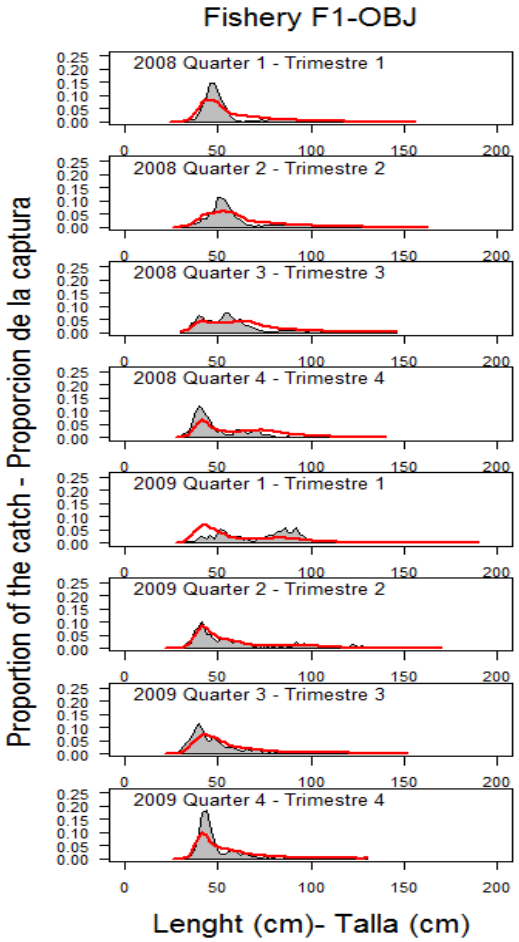
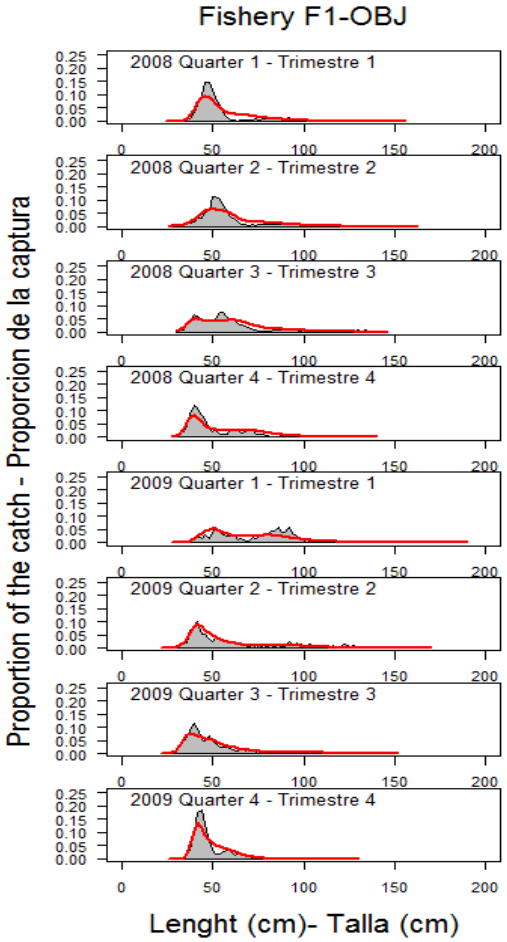
Fits to recent size comps.



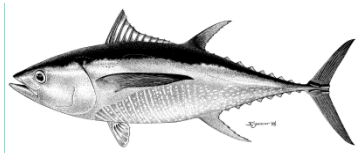
Time-invariant model 0



Time-variant model (M1-P2fix)



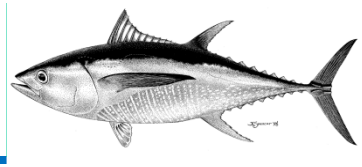
CIAT IATTC



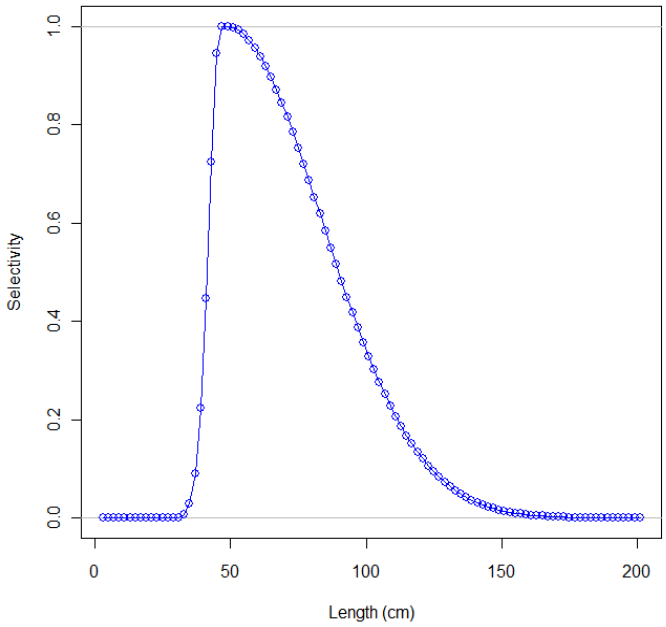
Model type 2

- Assume “average” stationary OBJ selectivity
- “Drop” (not fit) all OBJ LF data
- Fix to base selectivity parameters estimated in full time-varying runs (models 1)

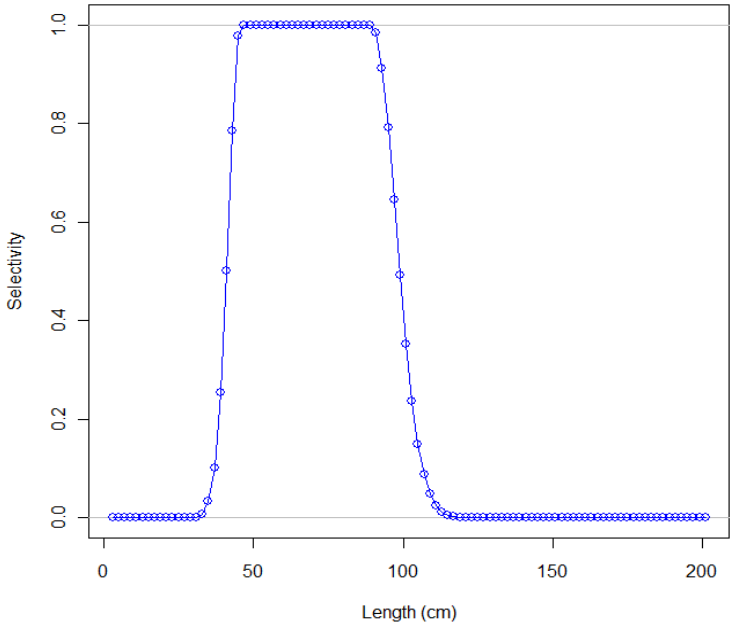
Model type 2



M2-P2fixed

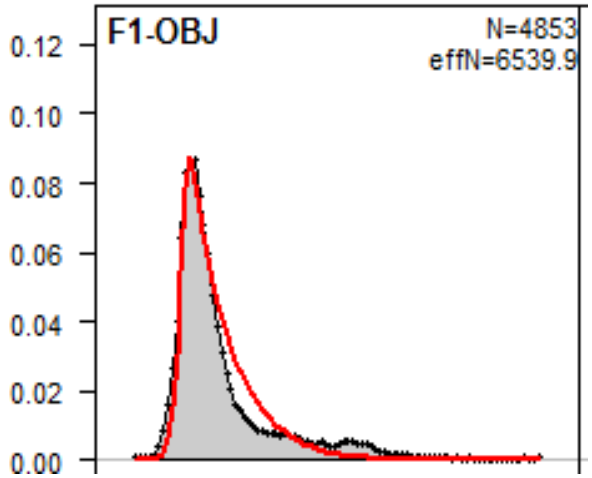


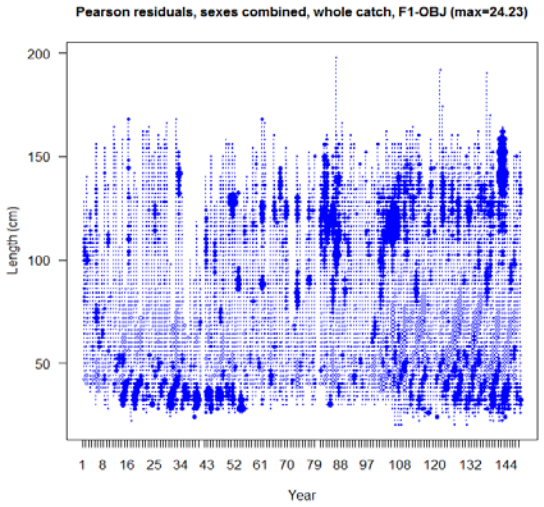
M2-P2est



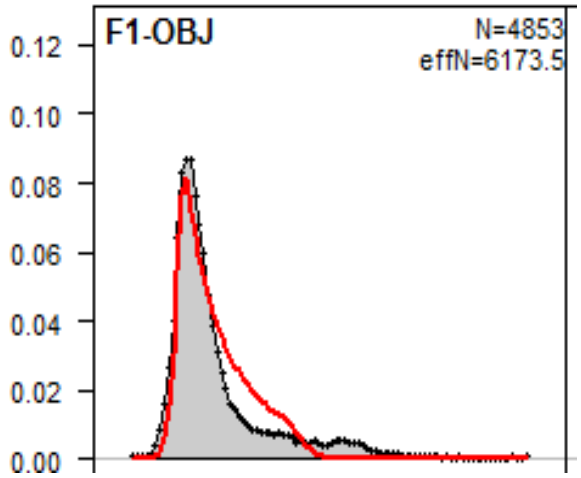
Model type 2

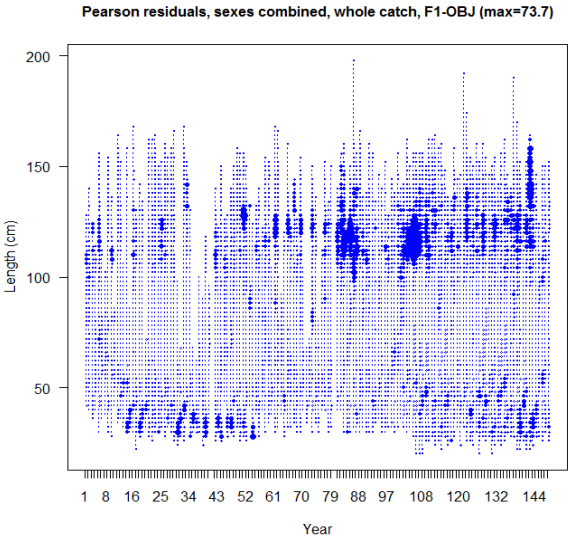
M2-P2fixed



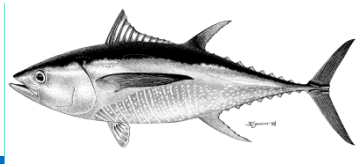


M2-P2est





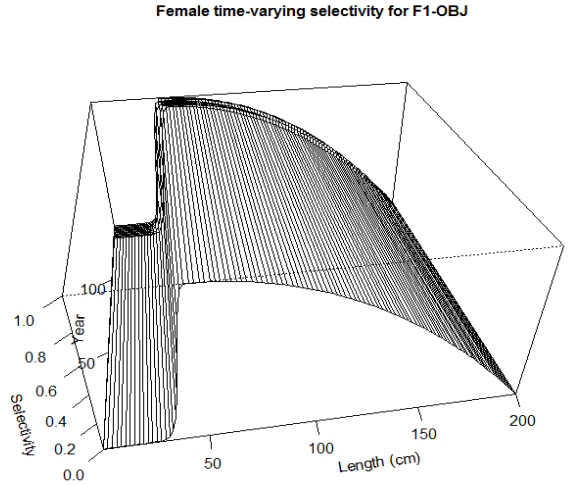
Model type 3

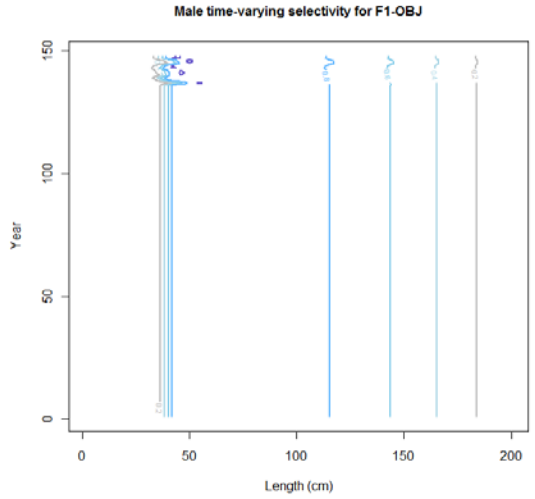


- **Recent period** is the most influential on management quantities (recent recruitments, *F*s)
- Time-varying selectivity process in **recent period only**
- Estimate quarterly deviates on base parameters of double normal OBJ selectivity curve
- Fit to OBJ LF data for **recent period only**
  - 3 terminal years (3-year average used for management quantities)
  - 5 terminal periods (a longer period)
- As for early period, fix to “average” stationary selectivity from terminal years (base parameters)

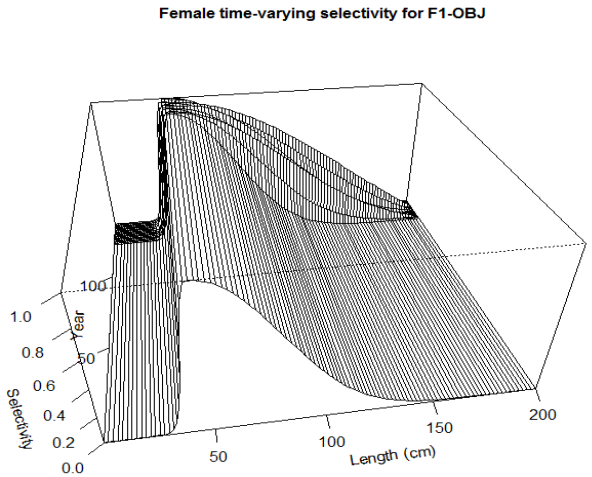
Model type 3

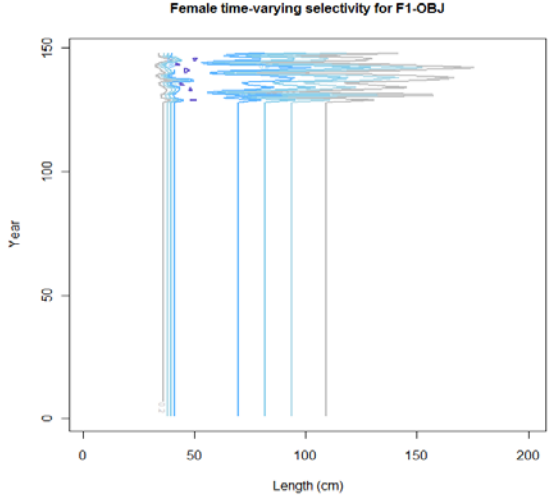
M4-P2fixed-3 years



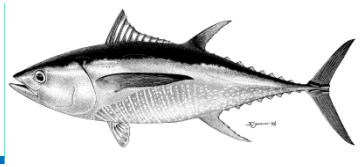


M4-P2fixed-5 years

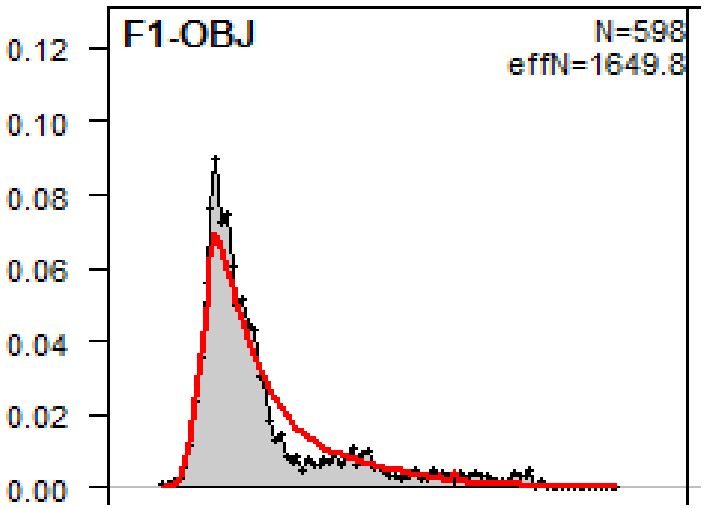


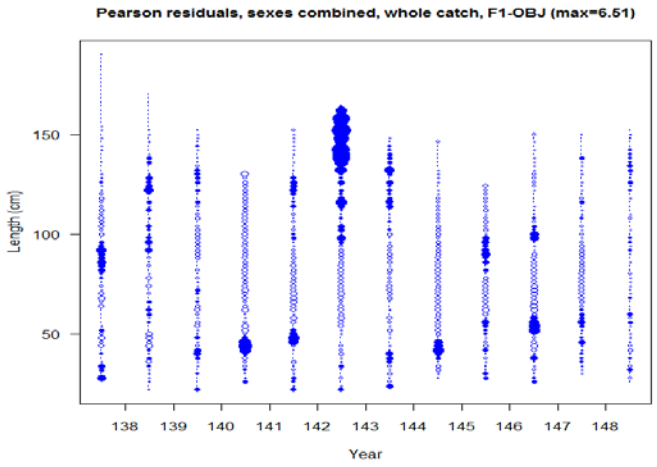


Model type 3

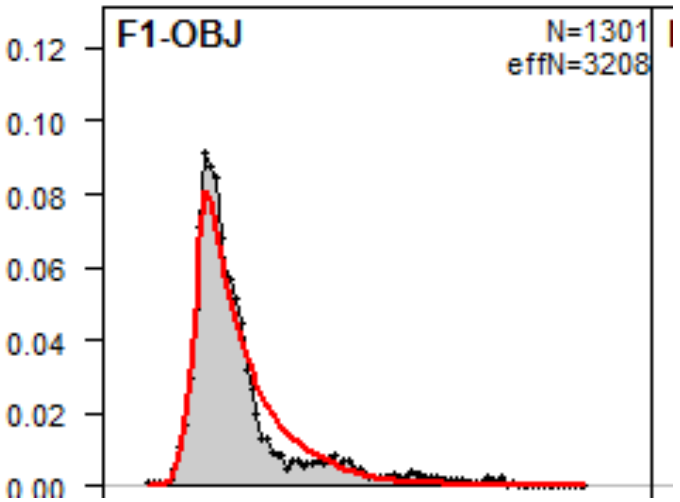


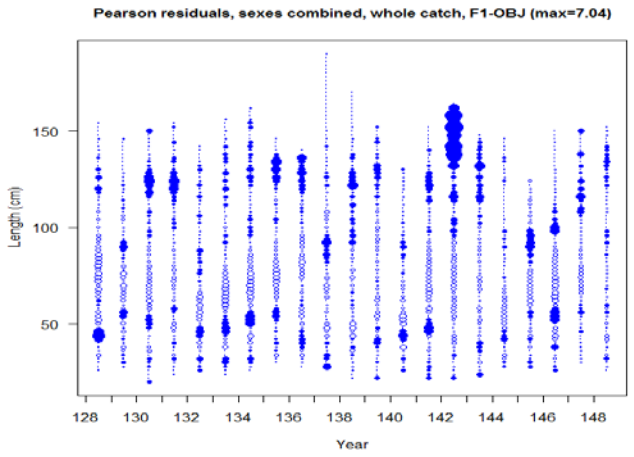
M4-P2fixed-3 years

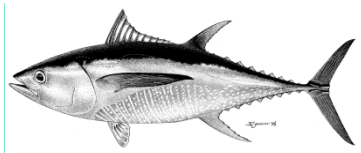




M4-P2fixed-5 years





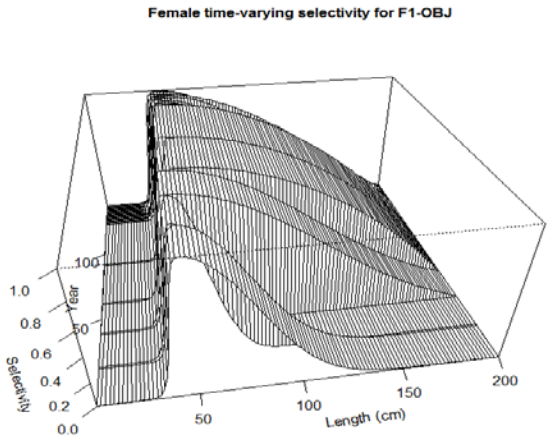


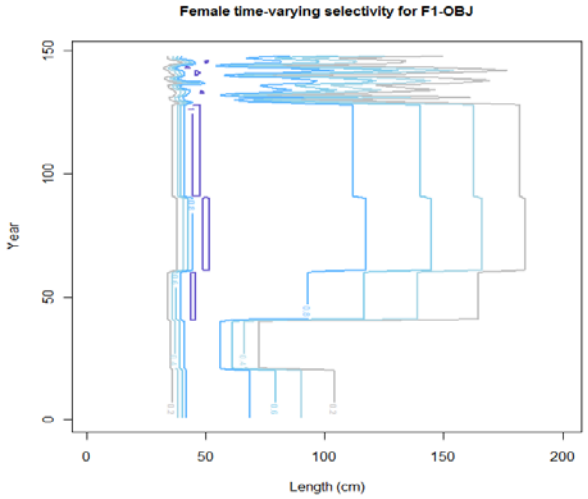
Model type 4

- Same as model 3 for terminal years (quarterly deviates)
- Use time blocks of time-varying selectivity for the early period
- Fit to OBJ LF data for all historic period

Model type 4

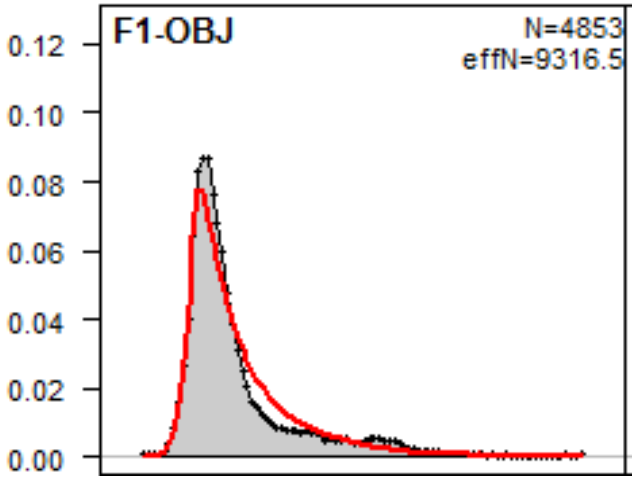
M4-P2fixed-5 years

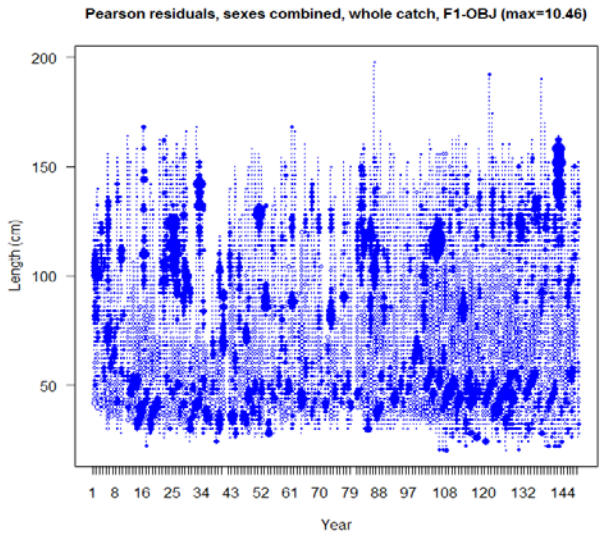




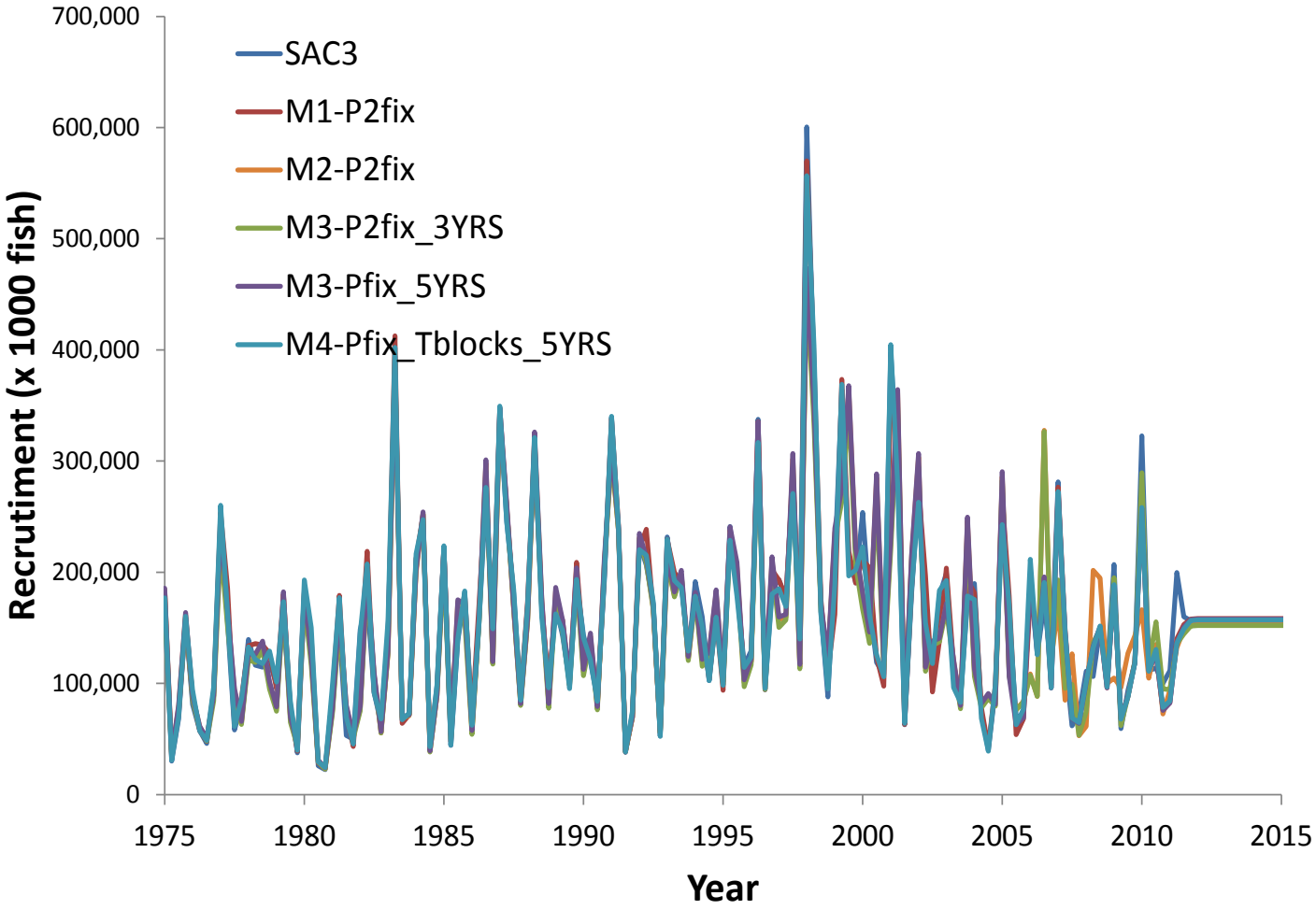
Model type 4

M4-P2fixed-5 years

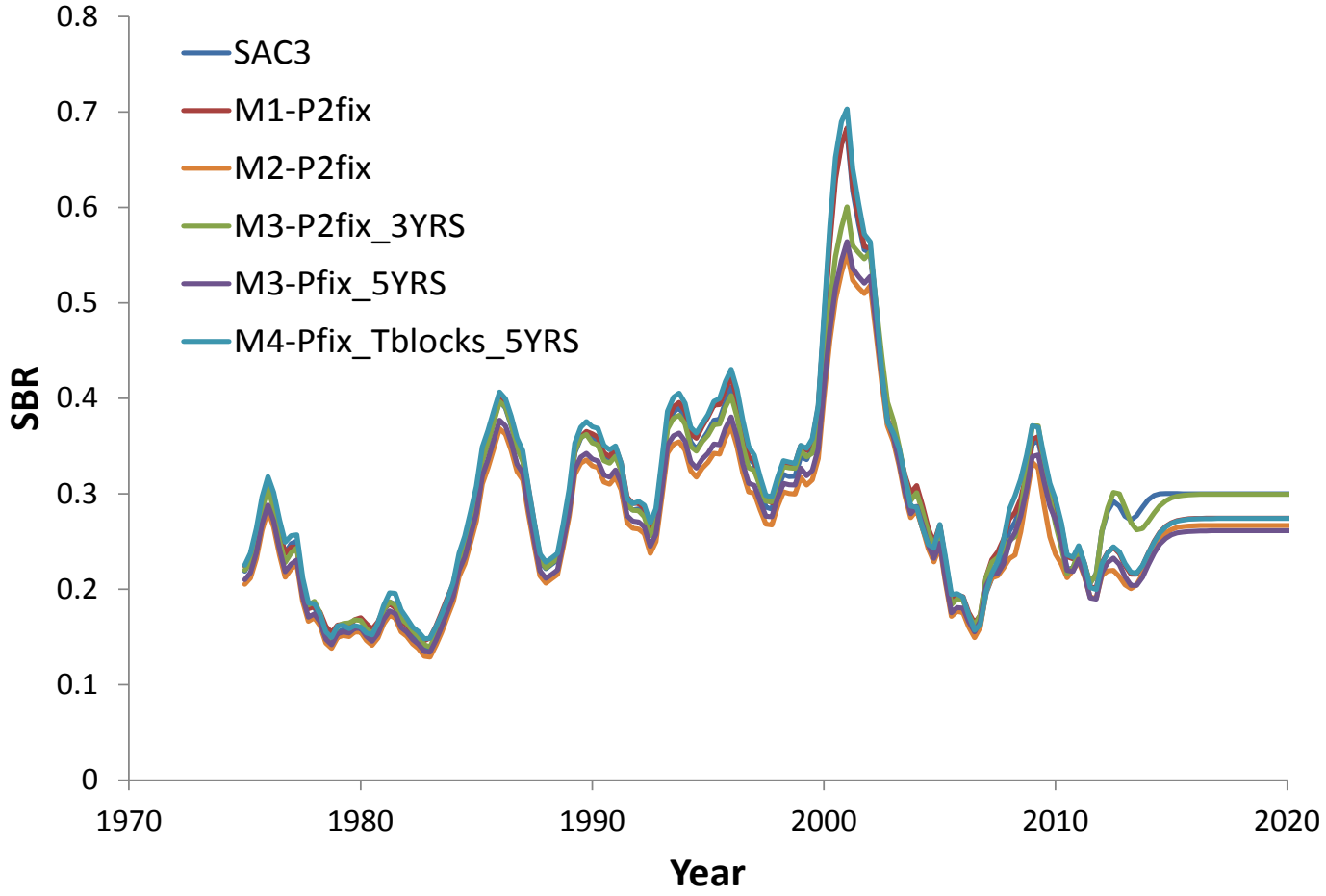




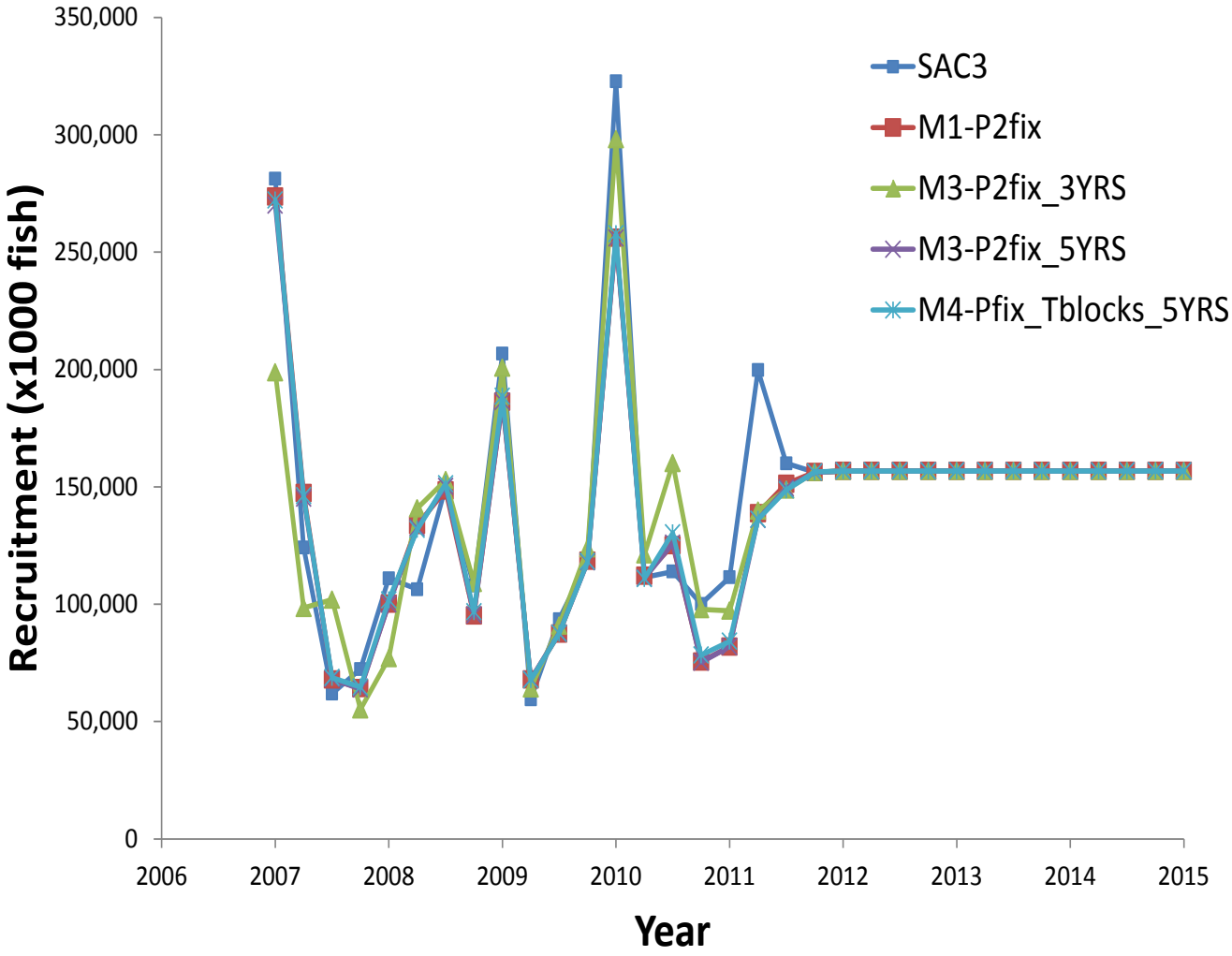
Recruitment – all models



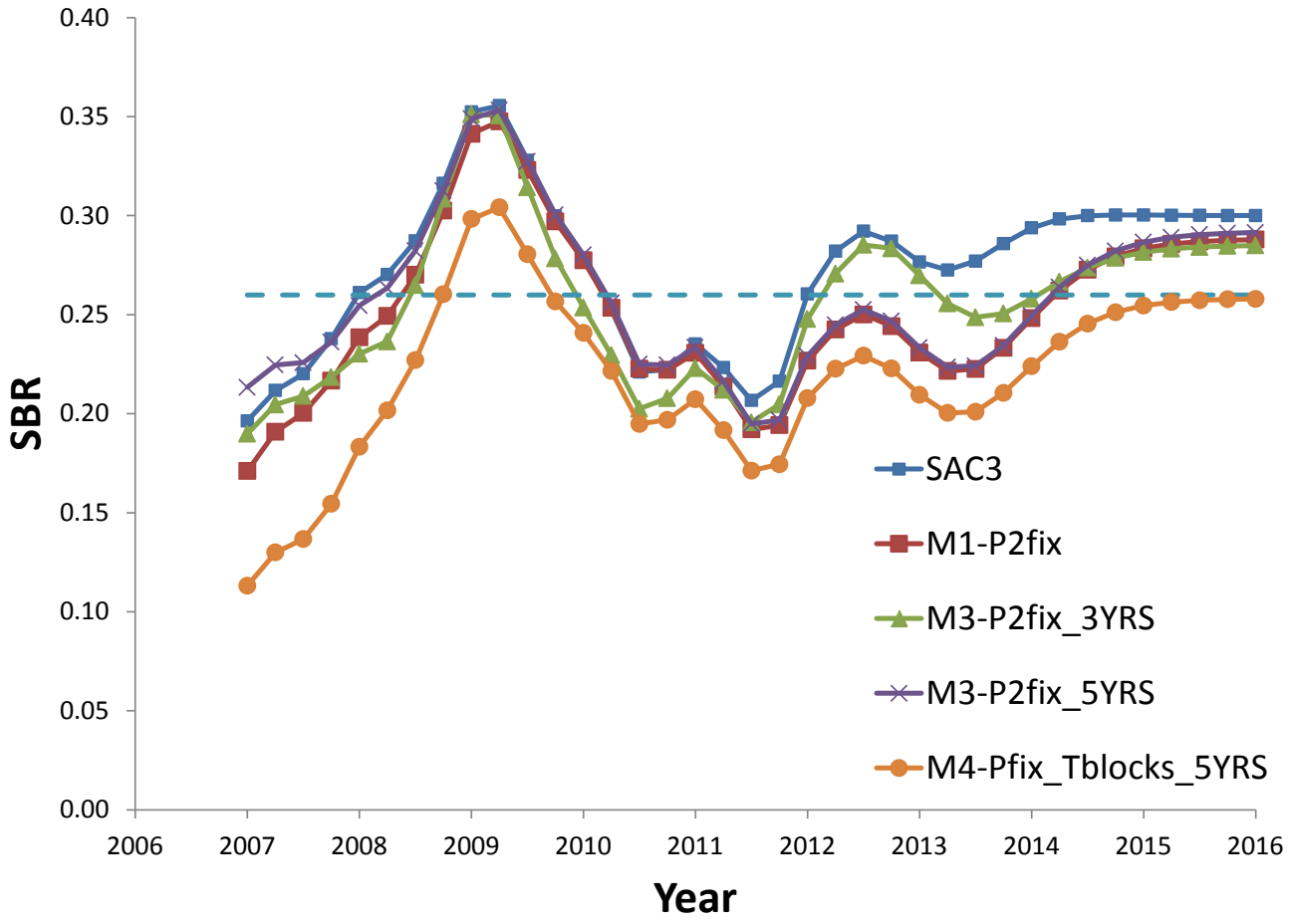
SBR – all models



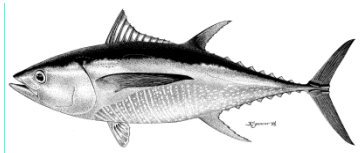
Retrospective pattern – recruitment



Retrospective pattern – SBR



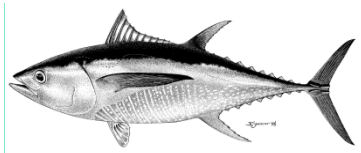
Model type 1



a) MODELS 0 and 1

	Model 0	MODEL 1 CONFIGURATION	
		M1-P2fixed	M1-P2est
Fit to OBJ LF	Yes, all period	Yes, all period	Yes, all period
Base sel params	Estimated	Estimated	Estimated
Devs	No	Yes, all qrts	Yes, all qrts
LIKELIHOOD COMPONENT			
TOTAL	7636.06	7156.94	7166.44
Catch	0.0053679	0.005368	0.00536794
Survey	-143.156	-157.596	-159.758
Length_comp	7784.19	7199.92	7215.39
Recruitment	-4.98712	-6.02737	-6.11765
Parm_softbounds	0.00778615	0.00638726	0.00607614
Parm_devs	0	120.63	116.919

Model type 1



a) MODELS 0 and 1

			MODEL 1 CONFIGURATION	
	SAC3	Model 0	M1-P2fixed	M1-P2est
Fit to OBJ LF	Yes	Yes, all period	Yes, all period	Yes, all period
Base sel params	Estimated	Estimated	Estimated	Estimated
Devs	No	No	Yes, all qrts	Yes, all qrts
MANAG QUANT				
msy	262,642	262,852	255,597	260,027
Bmsy	356,682	348,836	353,123	348,560
Smsy	3,334	3,208	3,304	3,203
Bmsy/Bzero	0.31	0.31	0.31	0.30
Smsy/Szero	0.26	0.25	0.25	0.25
Crecent/msy	0.79	0.78	0.81	0.79
Brecent/Bmsy	1.00	1.04	0.87	0.91
Srecent/Smsy	1.00	1.07	0.90	0.91
Fmultiplier	1.15	1.20	1.07	1.05

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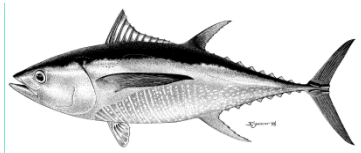
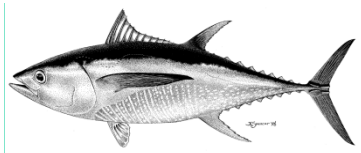


Model type 2

b) MODELS 2

	MODEL 2 CONFIGURATION	
	M2-P2fixed	**M2-P2est**
Fit to OBJ LF	No	No
Base sel params	Fixed to base M1a	Fixed to base M1b
Devs	No	No
LIKELIHOOD COMPONENT		
TOTAL	5956.61	5953.90
Catch	0.01	0.01
Survey	-162.30	-162.55
Length_comp	6129.17	6126.71
Recruitment	-10.28	-10.28
Parm_softbounds	0.00	0.00
Parm_devs	0.01	0.01

Model type 2

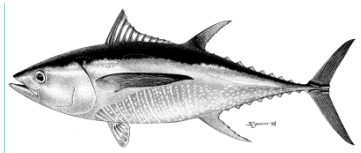


b) MODELS 2

	MODEL 2 CONFIGURATION	
	M2-P2fixed	**M2-P2est**
Fit to OBJ LF	No	No
Base sel params	Fixed to base M1	Fixed to base M1
Devs	No	No
MANAG QUANT		
msy	258,022	257,813
Bmsy	354,793	351,689
Smsy	3,341	3,279
Bmsy/Bzero	0.31	0.31
Smsy/Szero	0.26	0.26
Crecent/msy	0.8	0.8
Brecent/Bmsy	0.8	0.8
Srecent/Smsy	0.82	0.82
Fmultiplier	1.02	1.02

CIAT IATTC

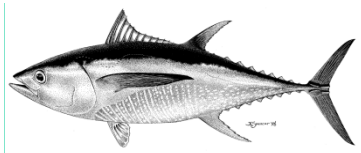
Model type 3



c) MODELS 3

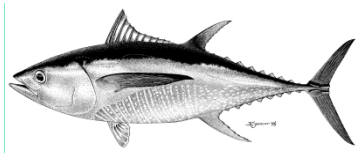
	MODEL 3 CONFIGURATION	
	M3-P2fixed-3yrs	**M3-P2fixed-5yrs**
Fit to OBJ LF	Yes, last 3 yrs	Yes, last 5 yrs
Base sel params	Estimated	Estimated
Devs	Yes, last 3 yrs	Yes, last 5 yrs
LIKELIHOOD COMPONENT		
TOTAL	6112.23	6218.83
Catch	0.01	0.01
Survey	-158.65	-161.58
Length_comp	6277.55	6373.07
Recruitment	-9.60	-9.63
Parm_priors	0.00	0.00
Parm_softbounds	0.01	0.01
Parm_devs	2.92	16.95

Model type 3



c) MODELS 3

	MODEL 3 CONFIGURATION	
	M3-P2fixed-3yrs	**M3-P2fixed-5yrs**
Fit to OBJ LF	Yes, last 3 yrs	Yes, last 5 yrs
Base sel params	Estimated	Estimated
Devs	Yes, last 3 yrs	Yes, last 5 yrs
MANAG QUANT		
msy	261,728	257,126
Bmsy	350,789	351,377
Smsy	3,278	3,273
Bmsy/Bzero	0.32	0.31
Smsy/Szero	0.26	0.25
Crecent/msy	0.79	0.8
Brecent/Bmsy	0.99	0.84
Srecent/Smsy	0.99	0.86
Fmultiplier	1.14	1.03

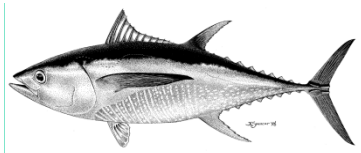


Model type 4

d) MODELS 4

	M4-5 tblocks
Fit to OBJ LF	Yes, last 5 yrs
Base sel params	Estimated
Devs	Yes, last 5 yrs
Time blocks early period	5 time blocks
LIKELIHOOD COMPONENT	
TOTAL	7446.08
Catch	0.00536796
Survey	-149.409
Length_comp	7587.71
Recruitment	-8.12982
Parm_priors	0.00E+00
Parm_softbounds	0.00649136
Parm_devs	15.894

CIAT IATTC



Model type 4

d) MODELS 4

	M4-5 tblocks
Fit to OBJ LF	Yes, last 5 yrs
Base sel params	Estimated
Devs	Yes, last 5 yrs
Time blocks early period	5 time blocks
MANAG QUANT	
msy	253,903
Bmsy	345,549
Smsy	3,191
Bmsy/Bzero	0.3
Smsy/Szero	0.25
Crecent/msy	0.81
Brecent/Bmsy	0.89
Srecent/Smsy	0.91
Fmultiplier	1.09