OCEANIC FISHERIES PROGRAMME
PROGRAMME PÊCHE HAUTURIÈRE

Status of Bigeye Tuna in the WCPO

Acknowledgements

Co-authors

- Adam Langley (SPC)
- Pierre Kleiber (NMFS, USA)
- Yukio Takeuchi (NRIFSF, Japan)
- Momoko Ichinokawa (NRIFSF)

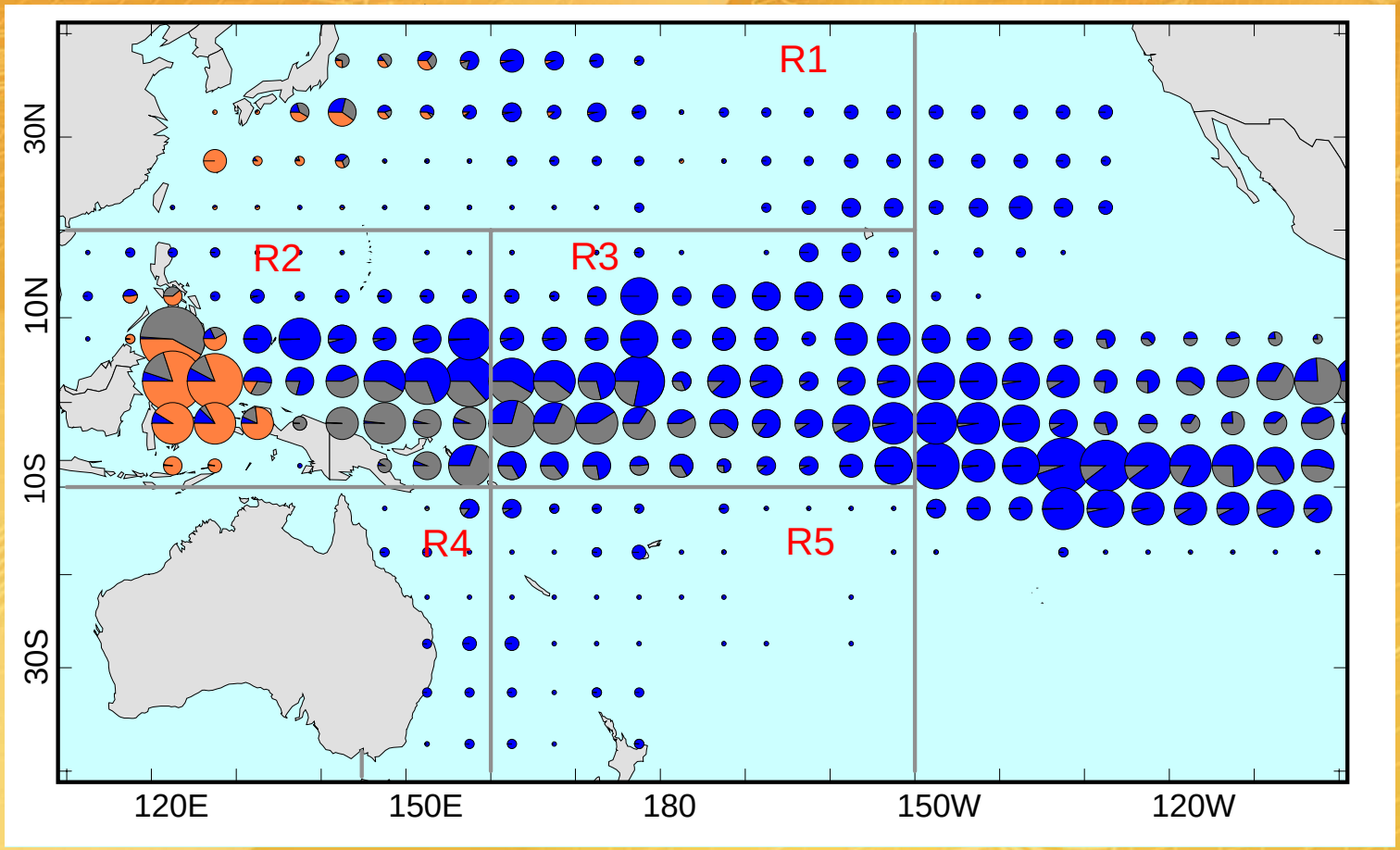
Bigeye Tuna Assessment

- Uses MULTIFAN-CL model
- Fit to catch, size and tagging data
- Cover the period 1952-2004, quarterly time step
- Age-structured model – 40 quarterly age-classes
- Estimated parameters – selectivity, catchability, movement, recruitment, SRR steepness, natural mortality, growth

Main Changes in the 2005 Assessment

1. Spatial structure

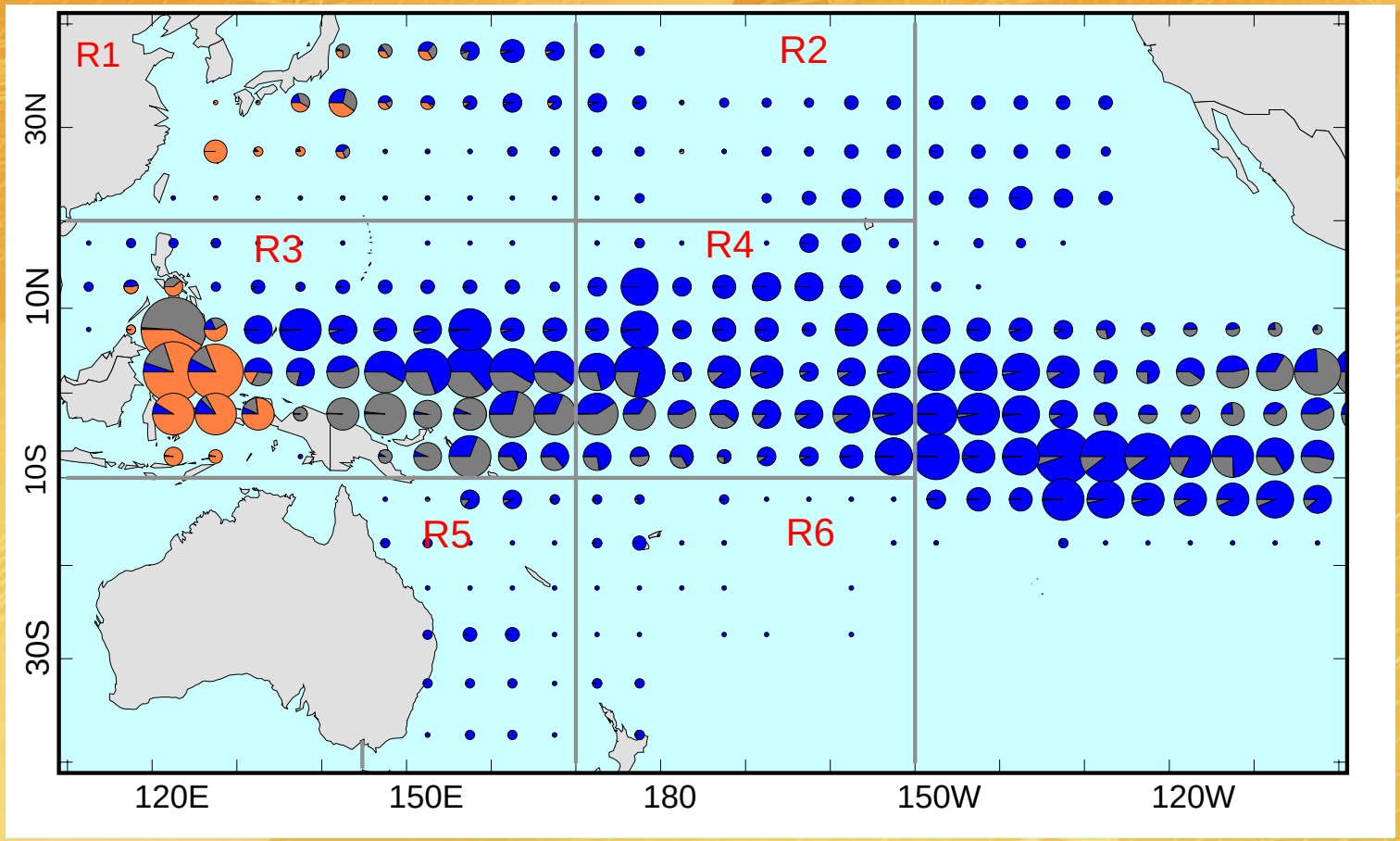
2004 assessment



Main Changes in the 2005 Assessment

1. Spatial structure

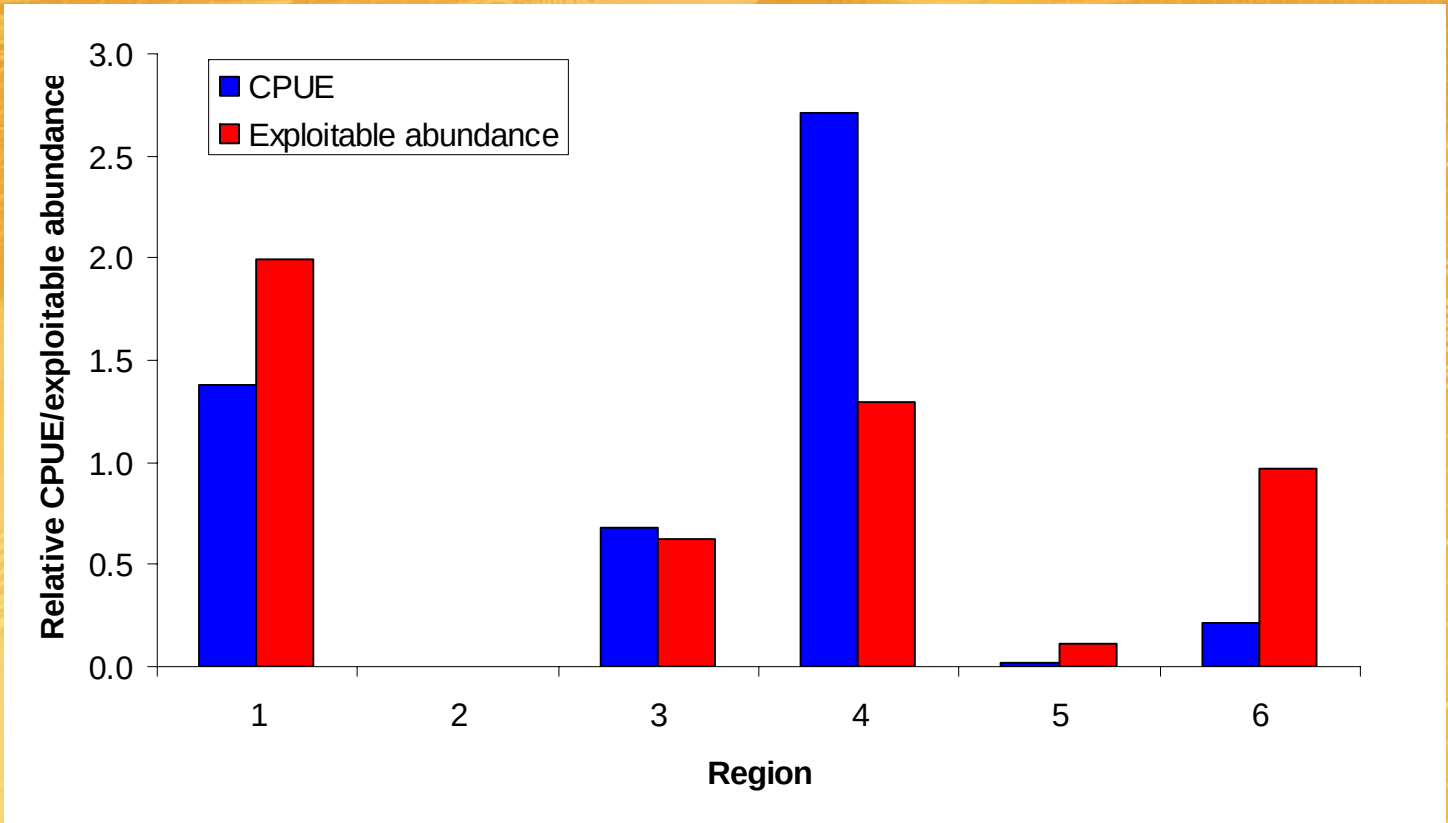
2005 assessment



Main Changes in the 2005 Assessment

2. Longline effort standardisation

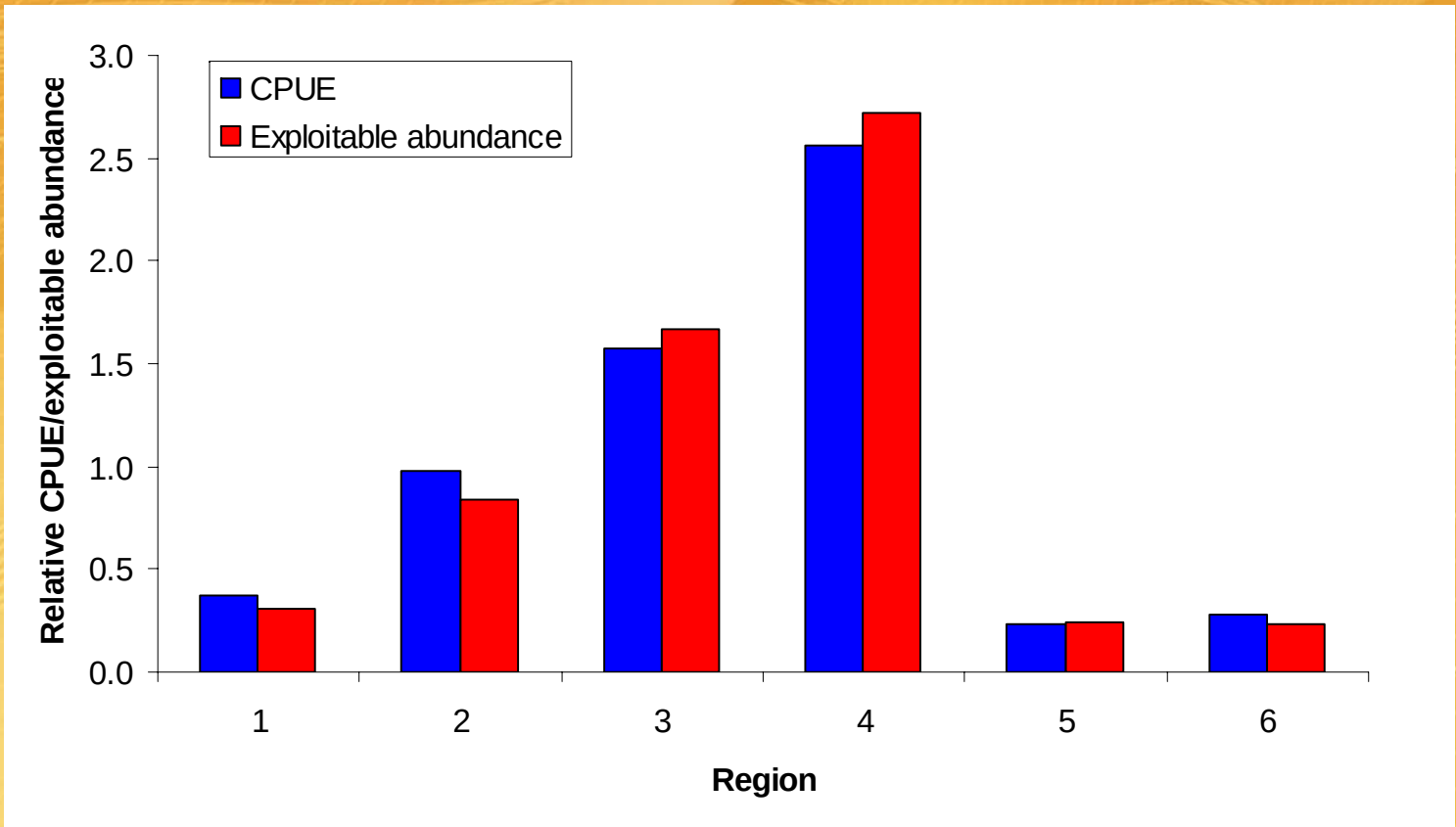
2004 assessment



Main Changes in the 2005 Assessment

2. Longline effort standardisation

2005 assessment



Main Changes in the 2005 Assessment

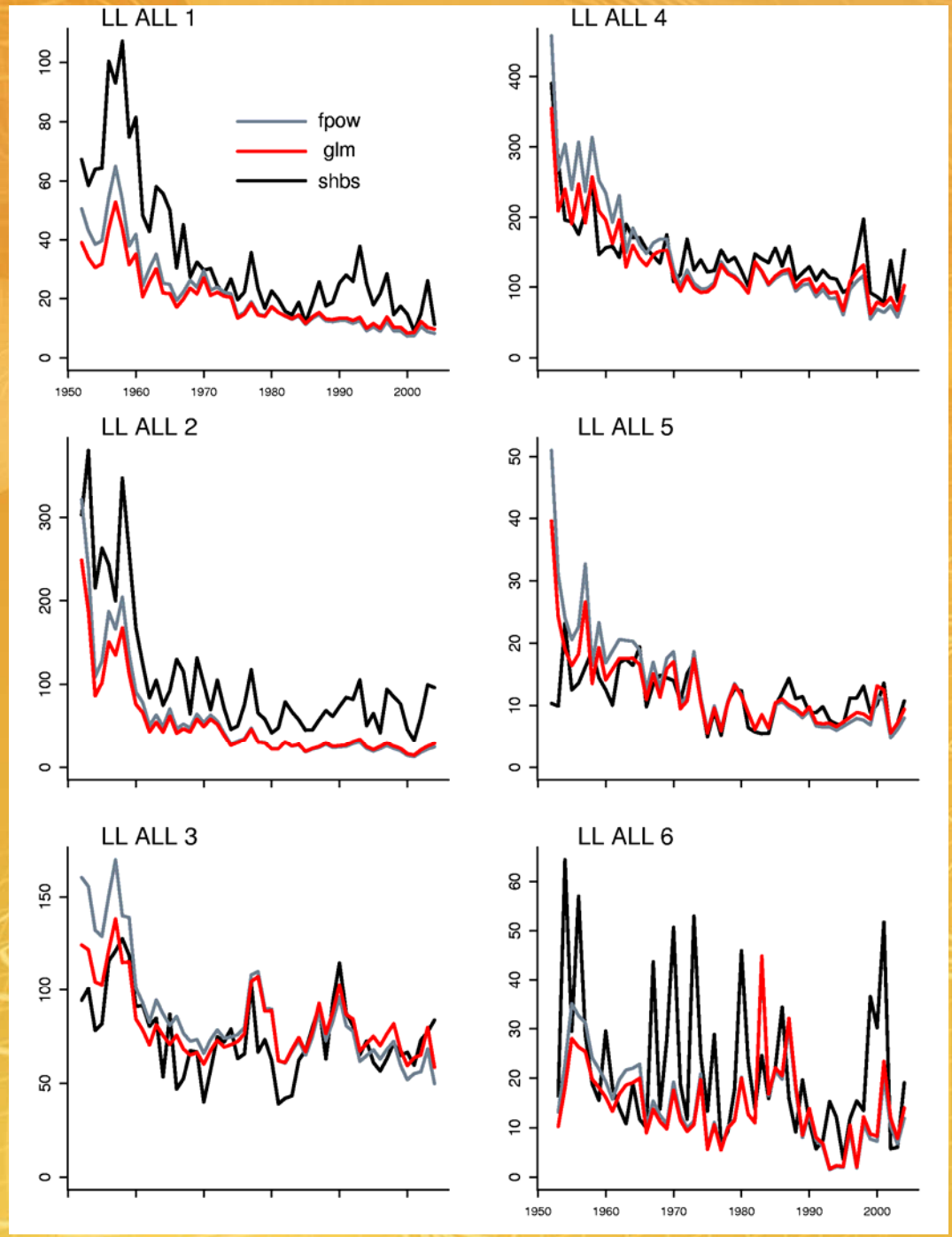
3. Longline size vs effort data weighting
4. Cubic spline selectivity
5. Weaker prior for Stock-Recruit Relationship steepness parameter
6. Inclusion of SRR in computation of unexploited population
7. Addition of recent fishery data – 2003 and 2004 for longline, 2004 for purse seine

Sensitivity Analyses

- GLM vs SHBS standardised longline effort
- Fixed vs estimated natural mortality
- Constant longline catchability vs 1% annual expansion in fishing power from 1952
- The expanded fishing power runs also included a 4% annual expansion of purse seine fishing power

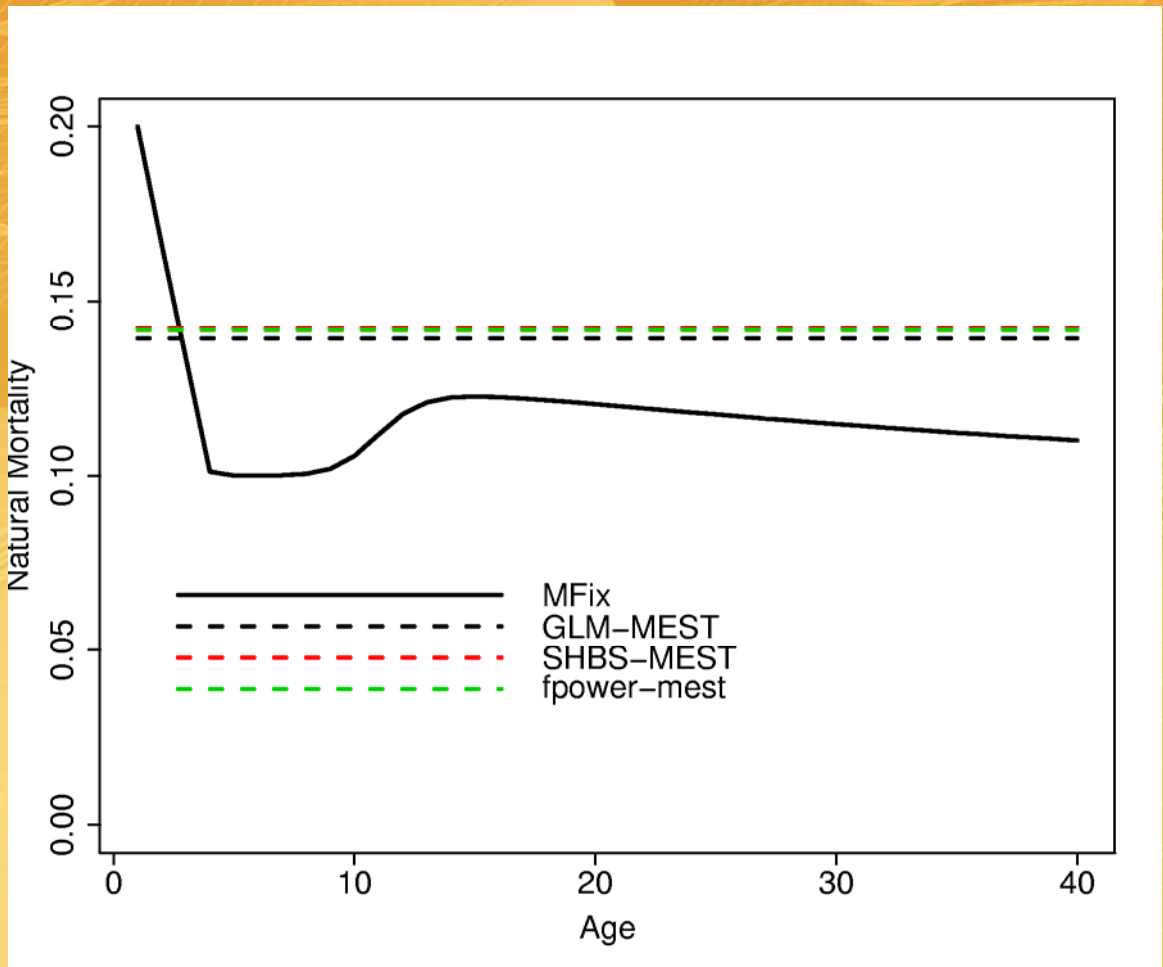
Sensitivity Analyses

GLM, SHBS, FPOW



Sensitivity Analyses

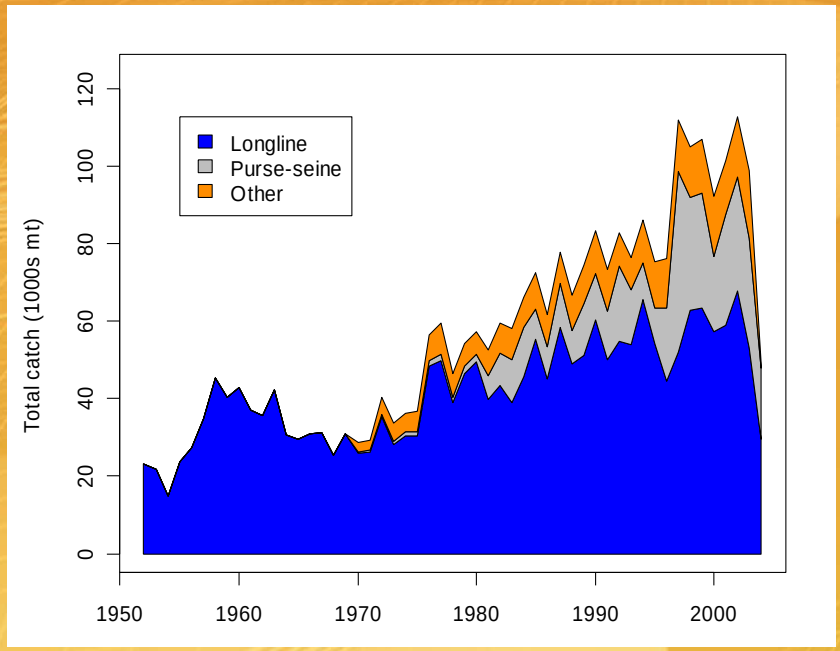
Fixed vs estimated *M*

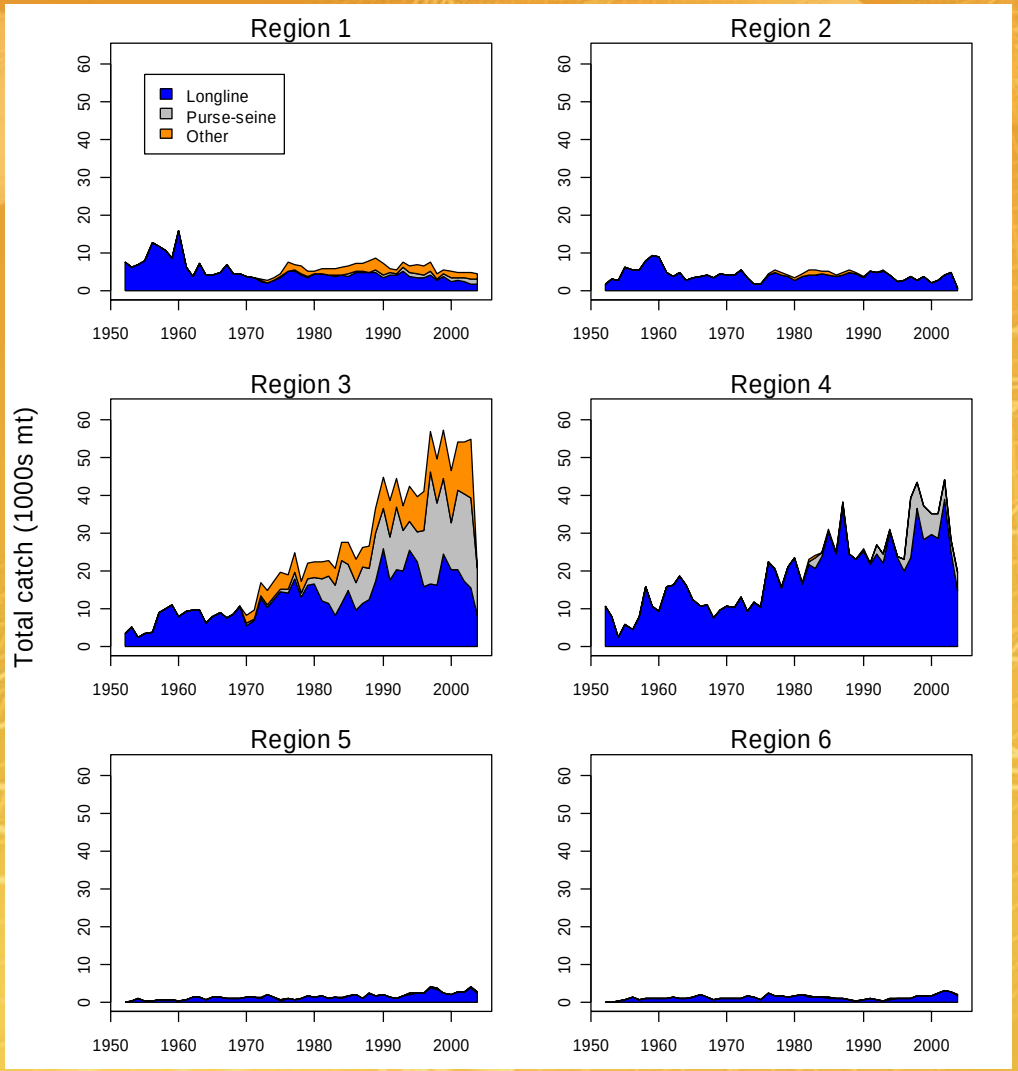


Sensitivity Analyses

- GLM-MFIX (base-case)
- GLM-MEST
- SHBS-MFIX
- SHBS-MEST
- FPOW-MFIX
- FPOW-MEST

Total Catch

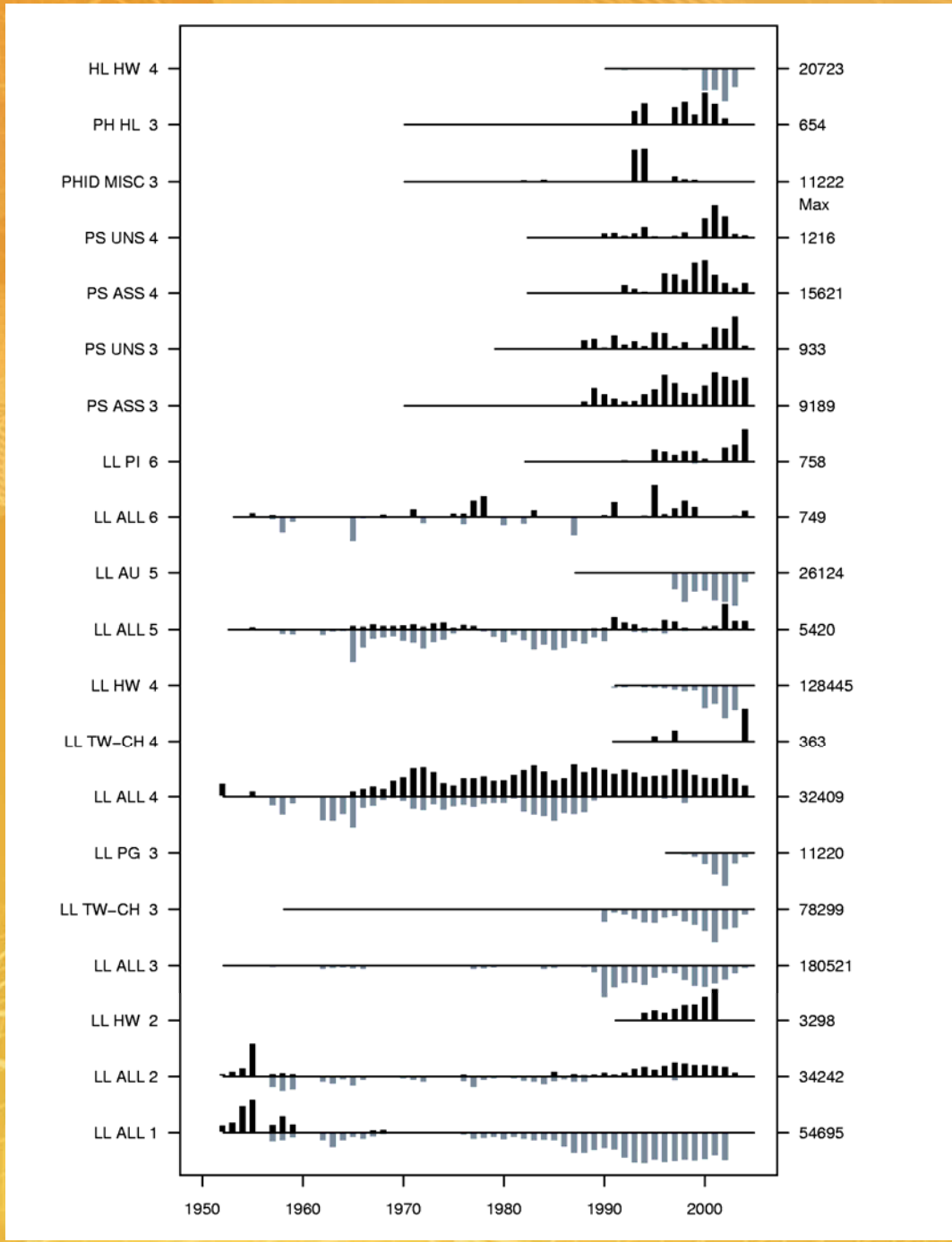

Longline
Purse-seine
Other
Total catch (1000s mt)
0
20
40
60
80
100
120
1950
1960
1970
1980
1990
2000


Region 1
Region 2
Region 3
Region 4
Region 5
Region 6
Longline
Purse-seine
Other
Total catch (1000s mt)
0
10
20
30
40
50
60
1950
1960
1970
1980
1990
2000

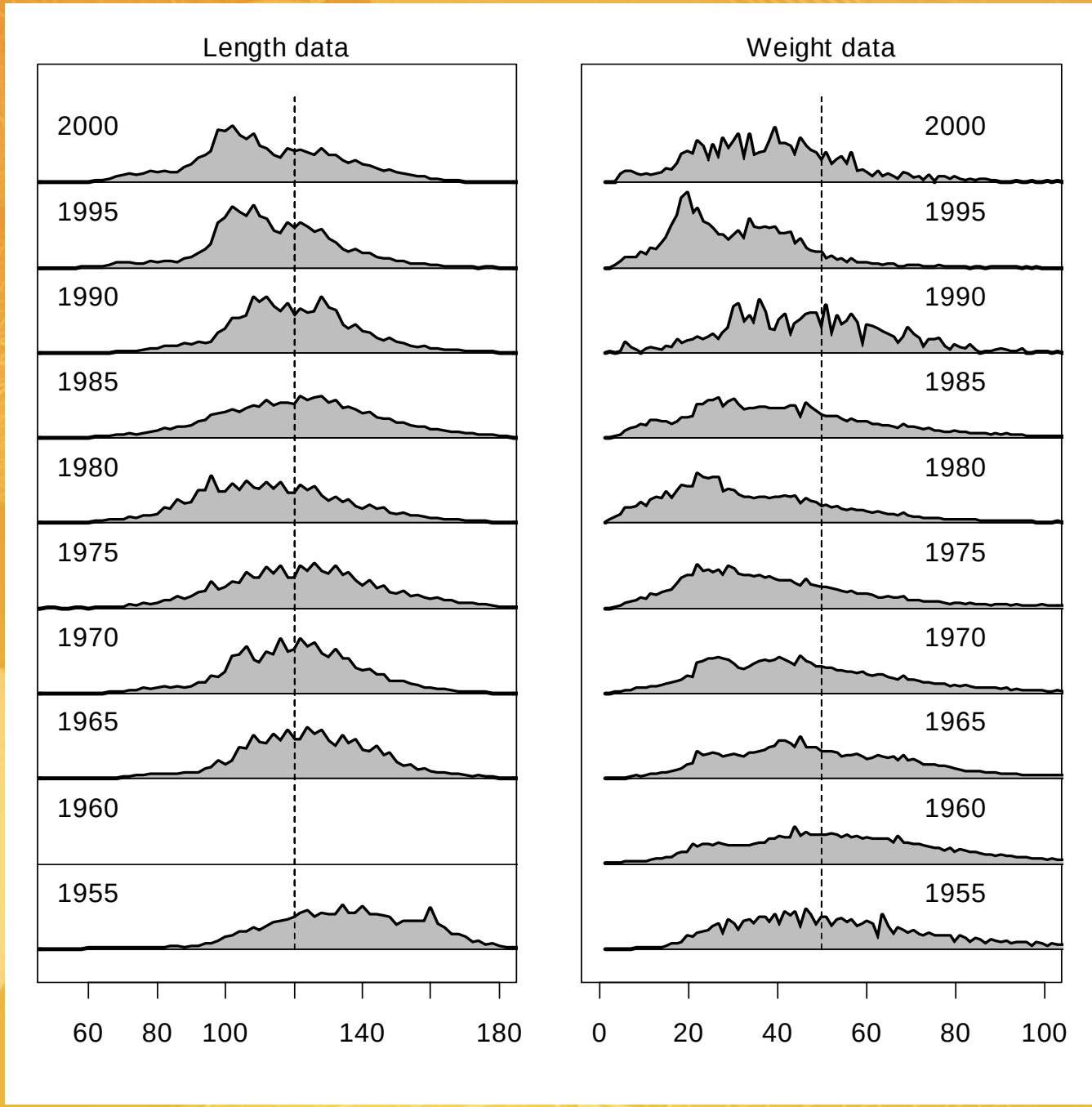
Fishery Definitions

Fishery Number	Reference Code	Nationality	Gear	Region
1	LL ALL 1	Japan, Korea, Chinese Taipei	Longline	1
2	LL ALL 2	Japan, Korea, Chinese Taipei	Longline	2
3	LL HW 2	United States (Hawaii)	Longline	2
4	LL ALL 3	All excl. Chinese Taipei & China	Longline	3
5	LL TW-CH 3	Chinese Taipei and China	Longline	3
6	LL PG 3	Papua New Guinea	Longline	4
7	LL ALL 4	Japan, Korea	Longline	4
8	LL TW-CH 4	Chinese Taipei and China	Longline	4
9	LL HW 4	United States (Hawaii)	Longline	4
10	LL ALL 5	All excl. Australia	Longline	5
11	LL AU 5	Australia	Longline	5
12	LL ALL6	Japan, Korea, Chinese Taipei	Longline	6
13	LL PI 6	Pacific Island Countries/Territories	Longline	6
14	PS ASS 3	All	Purse seine, log/FAD sets	3
15	PS UNS 3	All	Purse seine, school sets	3
16	PS ASS 4	All	Purse seine, log/FAD sets	4
17	PS UNS 4	All	Purse seine, school sets	4
18	PHID MISC 3	Philippines, Indonesia	Miscellaneous (small fish)	3
19	PH HL 3	Philippines, Indonesia	Handline (large fish)	3
20	HL HW 4	United States (Hawaii)	Handline	4

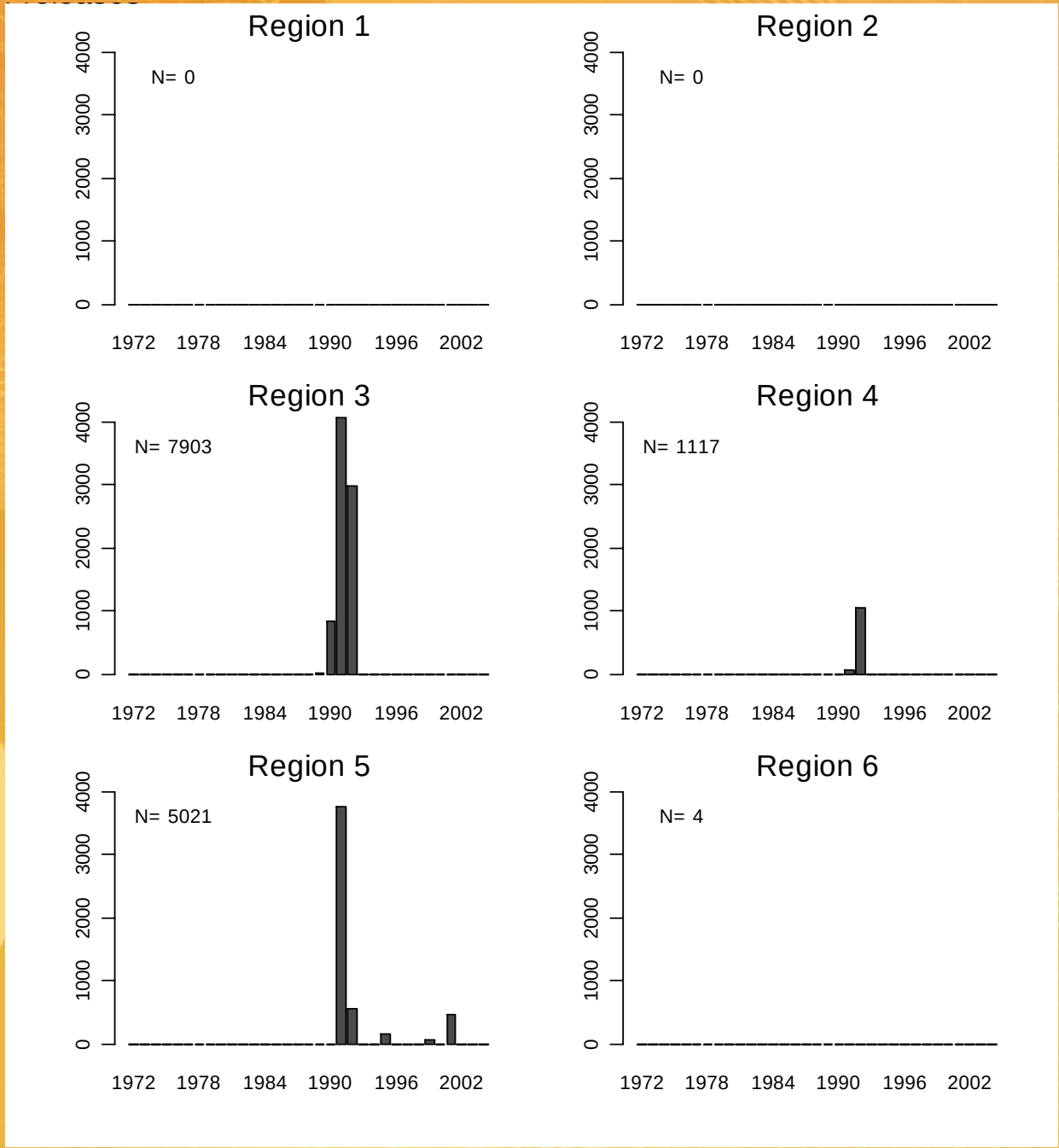
Size Data


HL HW 4
PH HL 3
PHID MISC 3
PS UNS 4
PS ASS 4
PS UNS 3
PS ASS 3
LL PI 6
LL ALL 6
LL AU 5
LL ALL 5
LL HW 4
LL TW–CH 4
LL ALL 4
LL PG 3
LL TW–CH 3
LL ALL 3
LL HW 2
LL ALL 2
LL ALL 1
20723
654
11222
Max
1216
15621
933
9189
758
749
26124
5420
128445
363
32409
11220
78299
180521
3298
34242
54695
1950
1960
1970
1980
1990
2000

Size Data (LL 4)

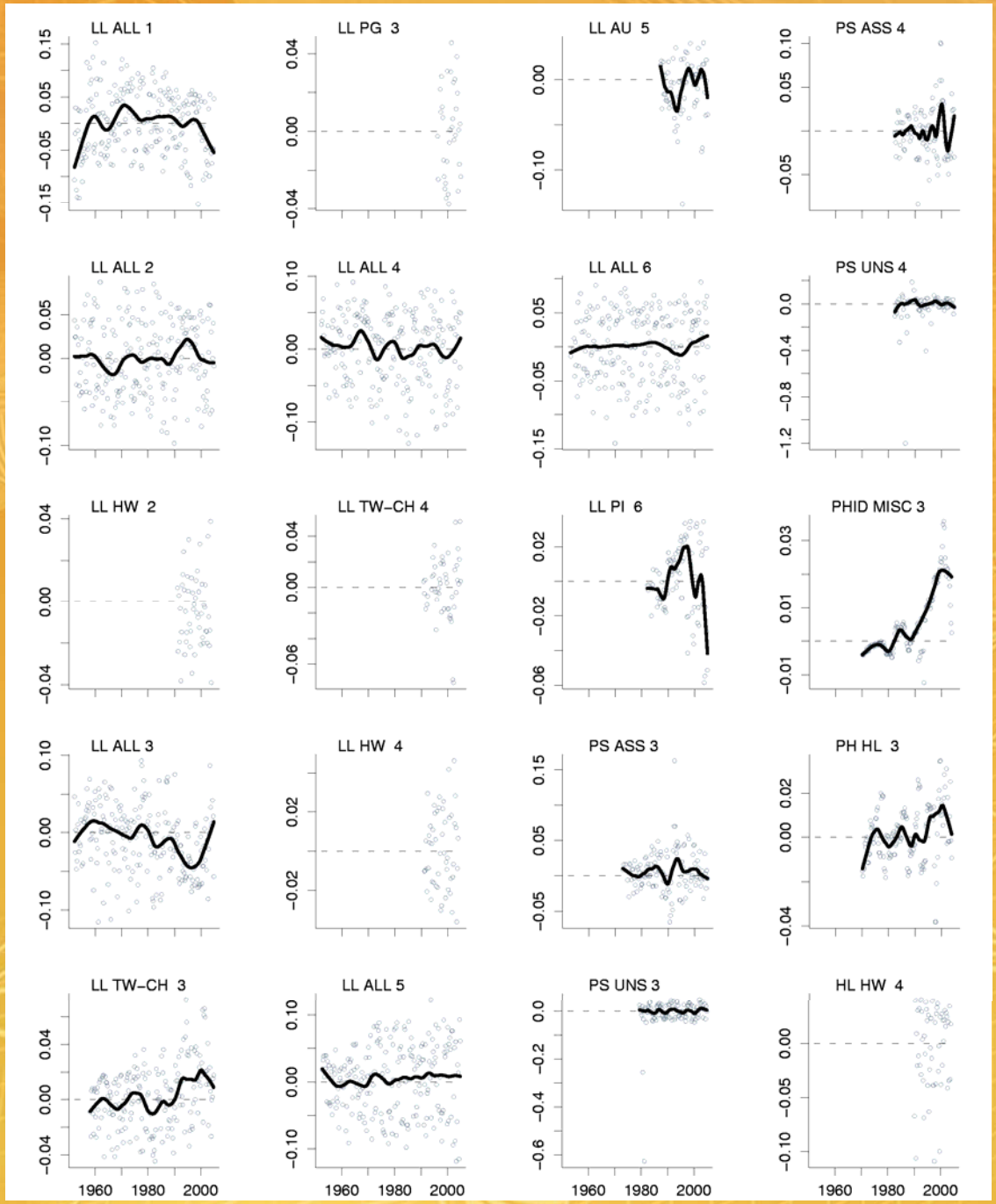


Tag Data (releases)



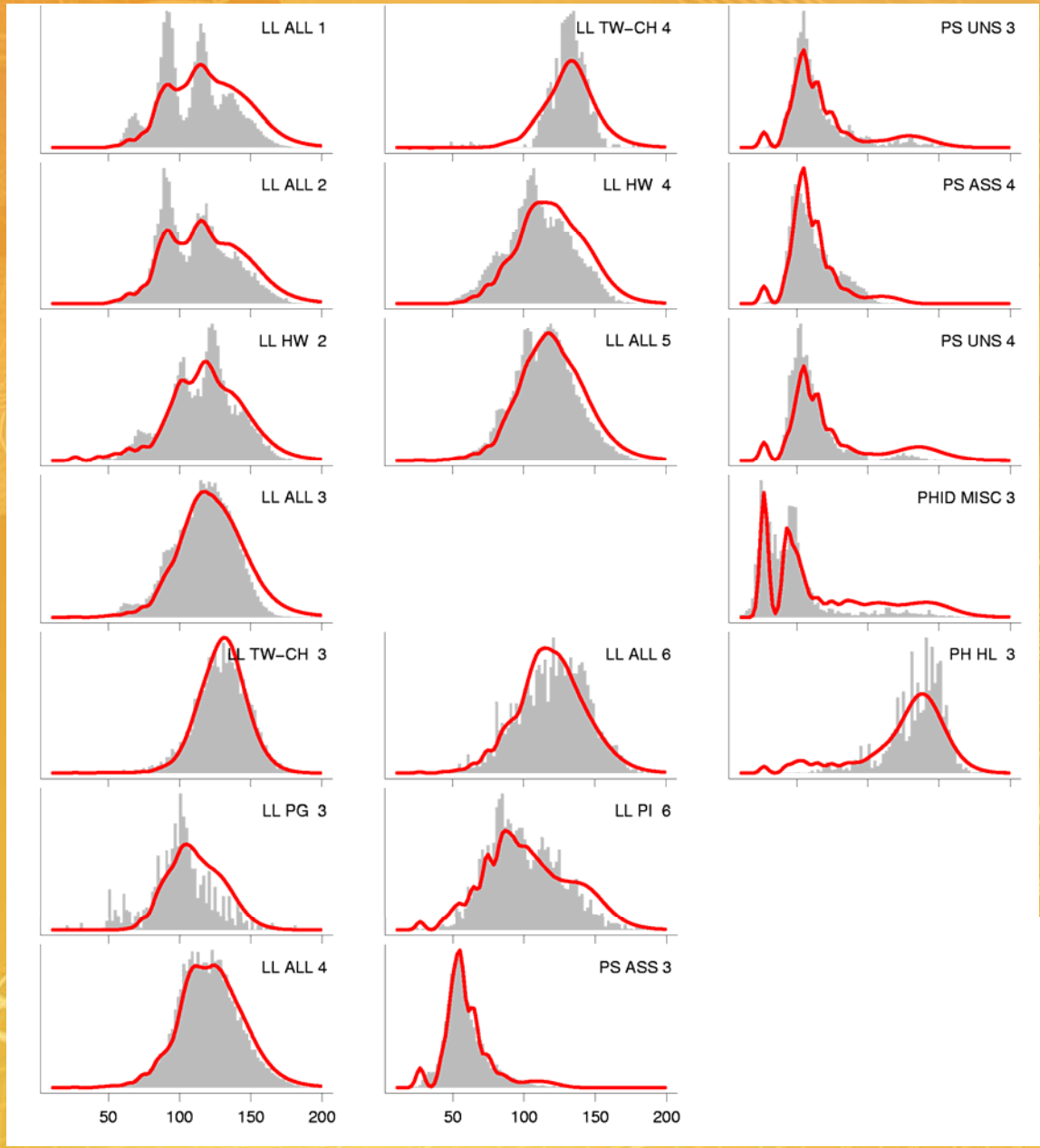
Model Diagnostics

1. Total Catch Fits



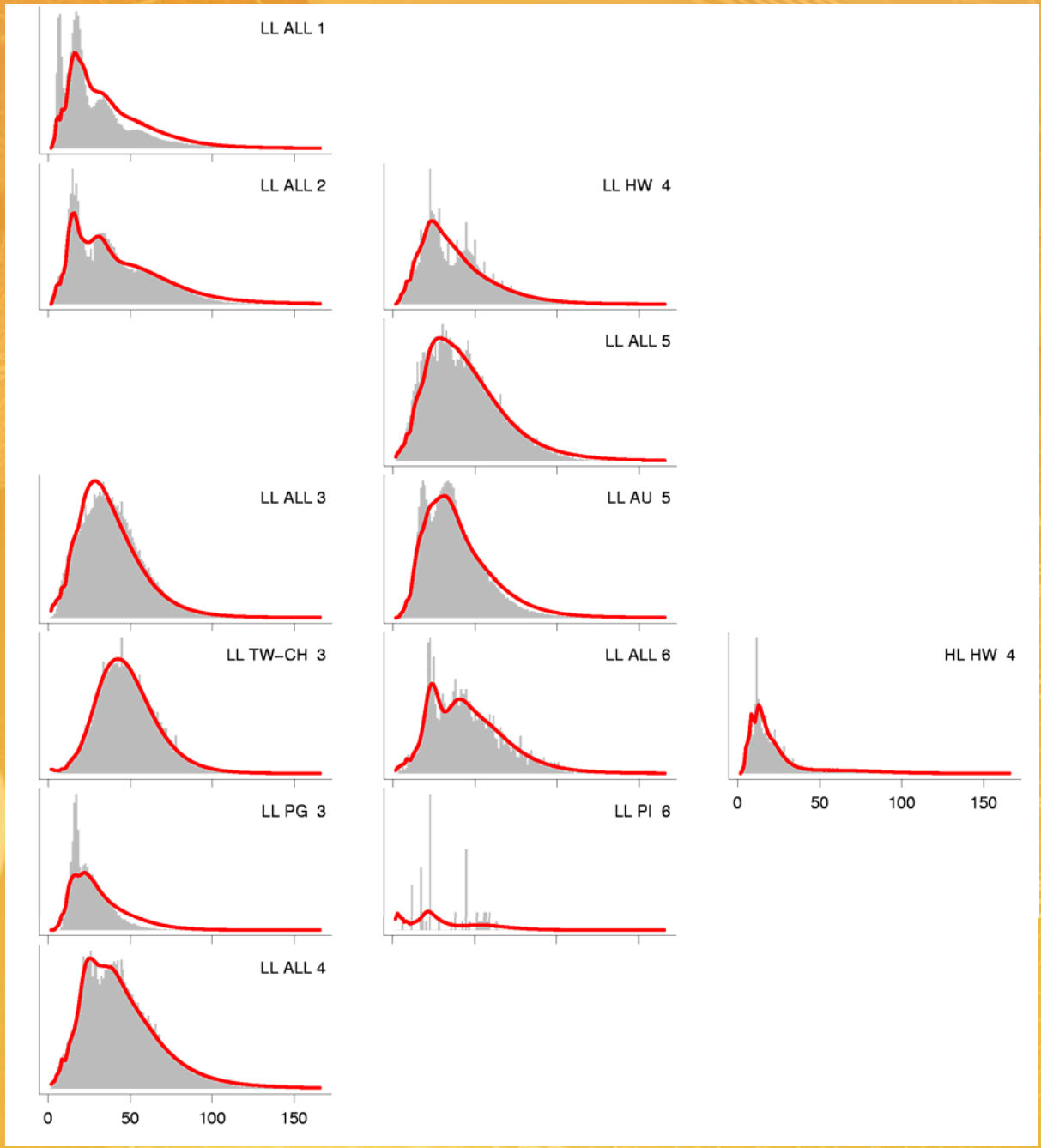
Model Diagnostics

2. Length Data Fits



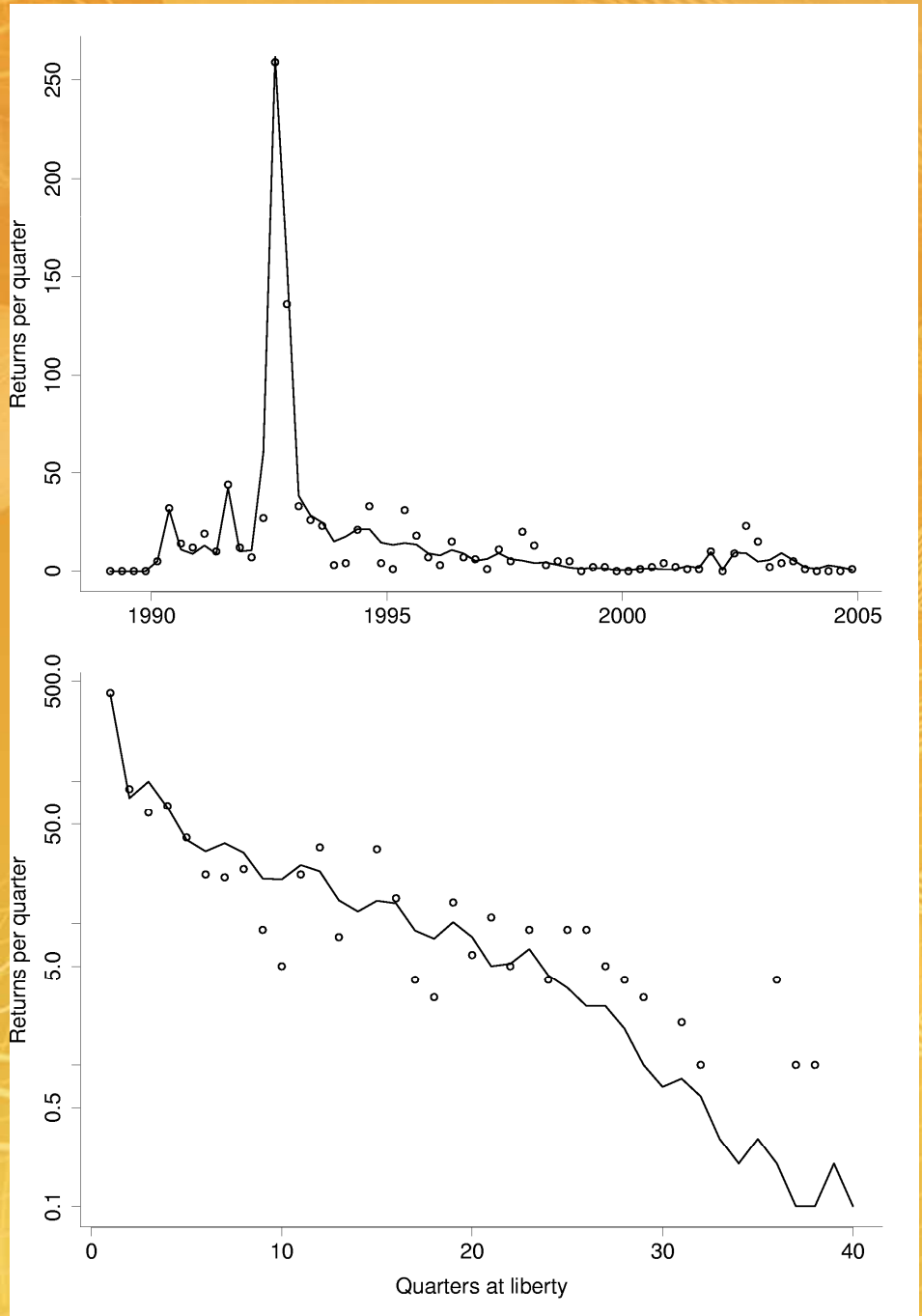
Model Diagnostics

3. Weight Data Fits



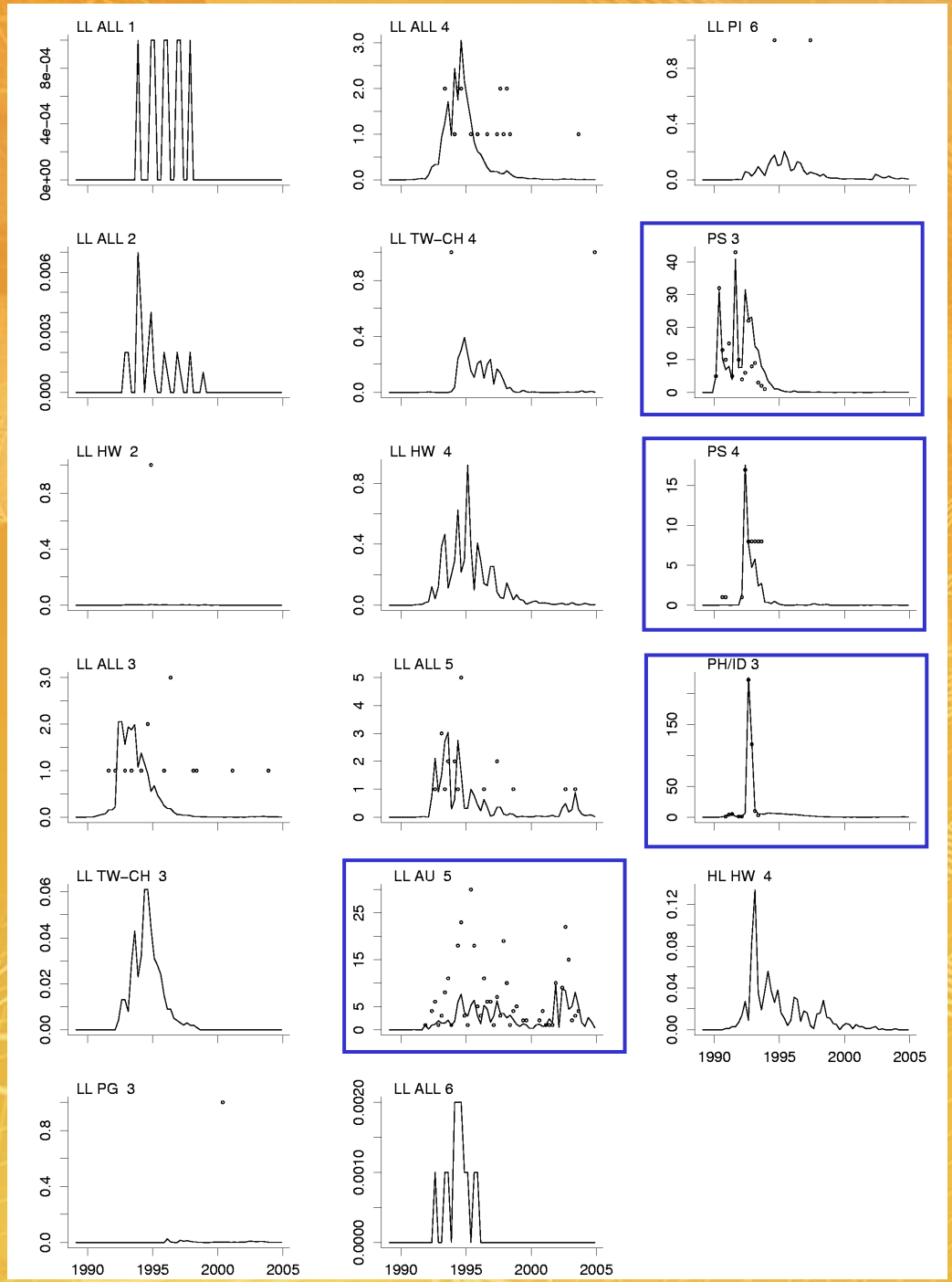
Model Diagnostics

4. Tag Data Fits



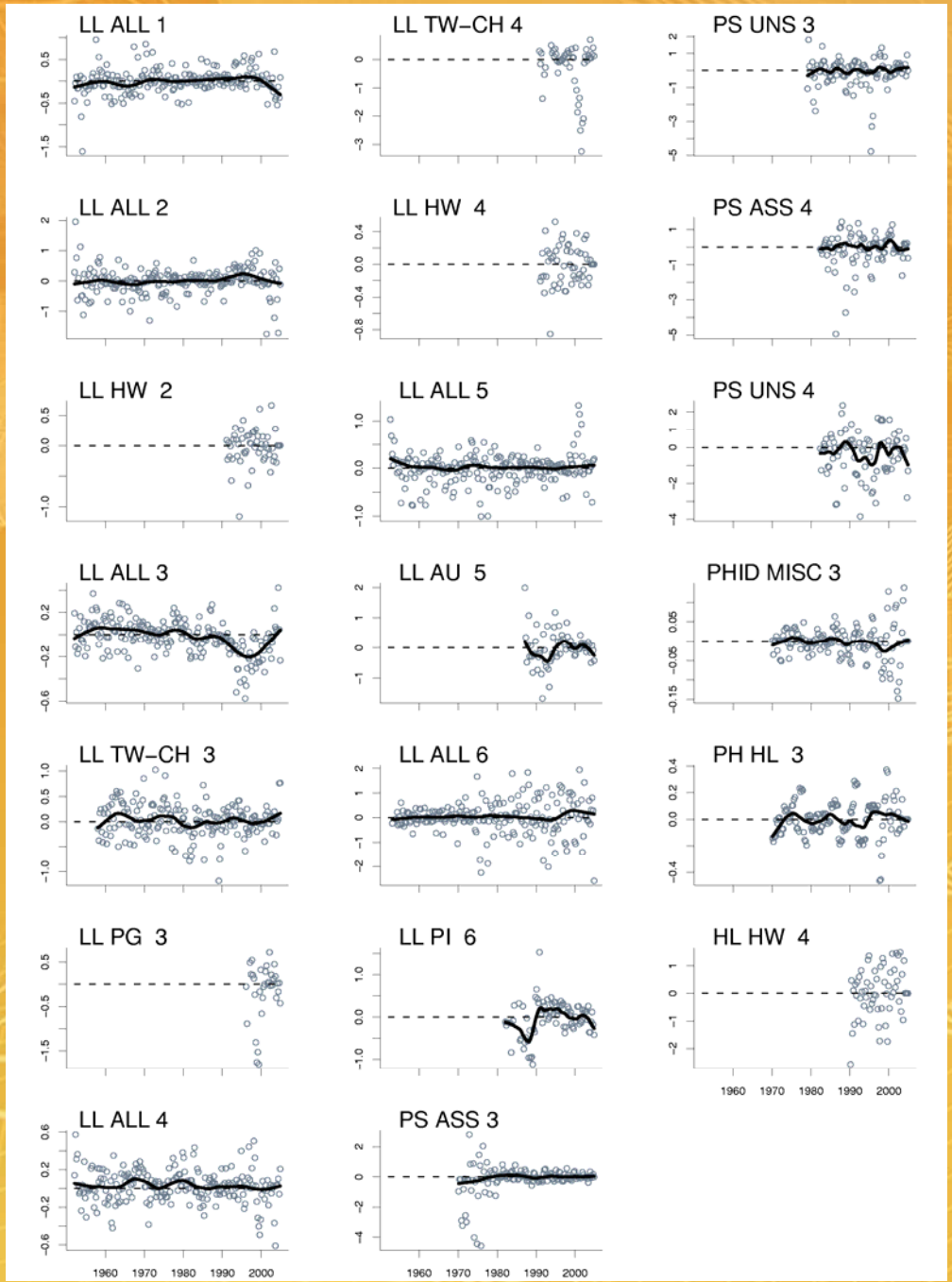
Model Diagnostics

4. Tag Data Fits by Fishery



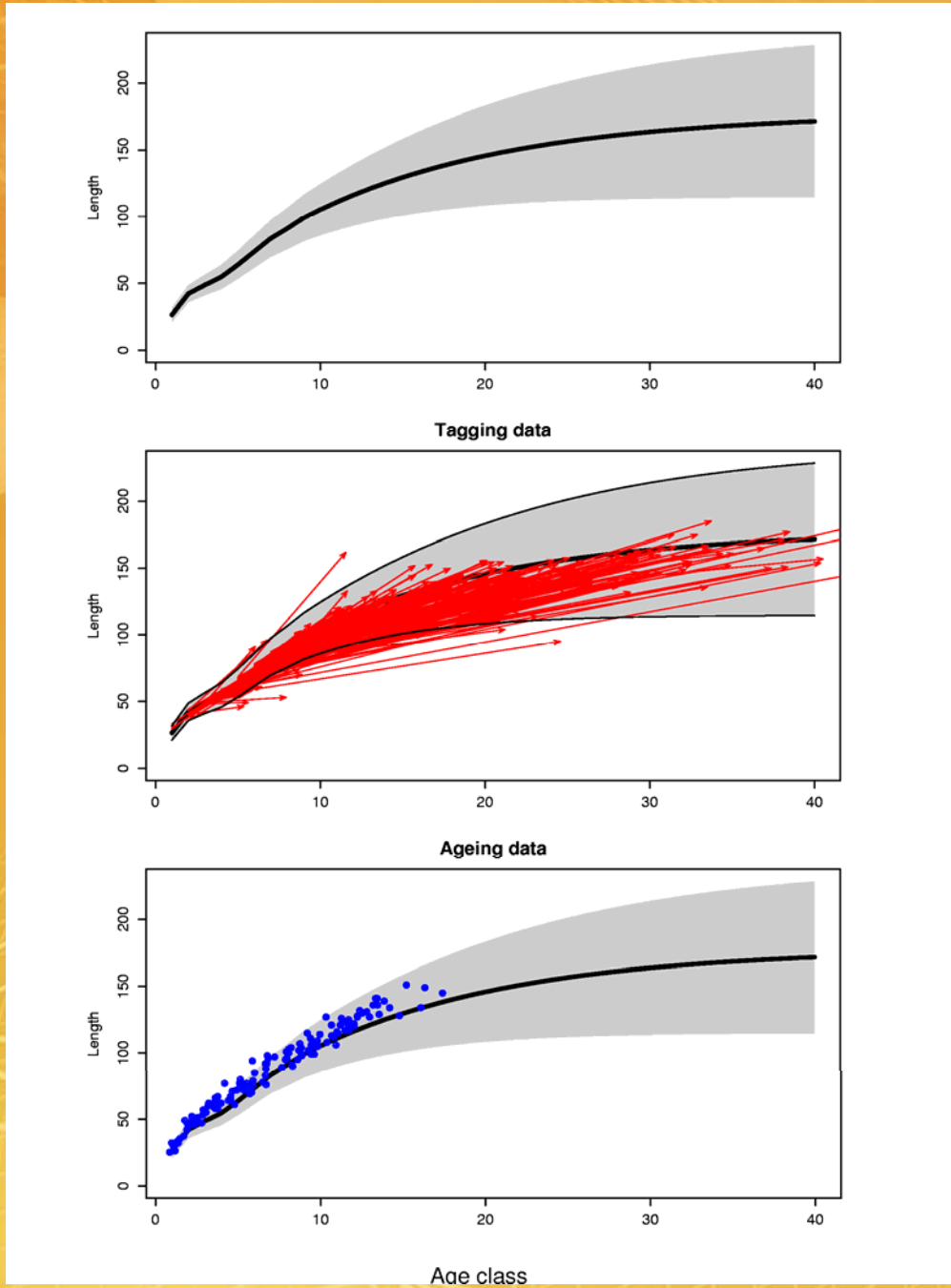
Model Diagnostics

5. Effort Deviations



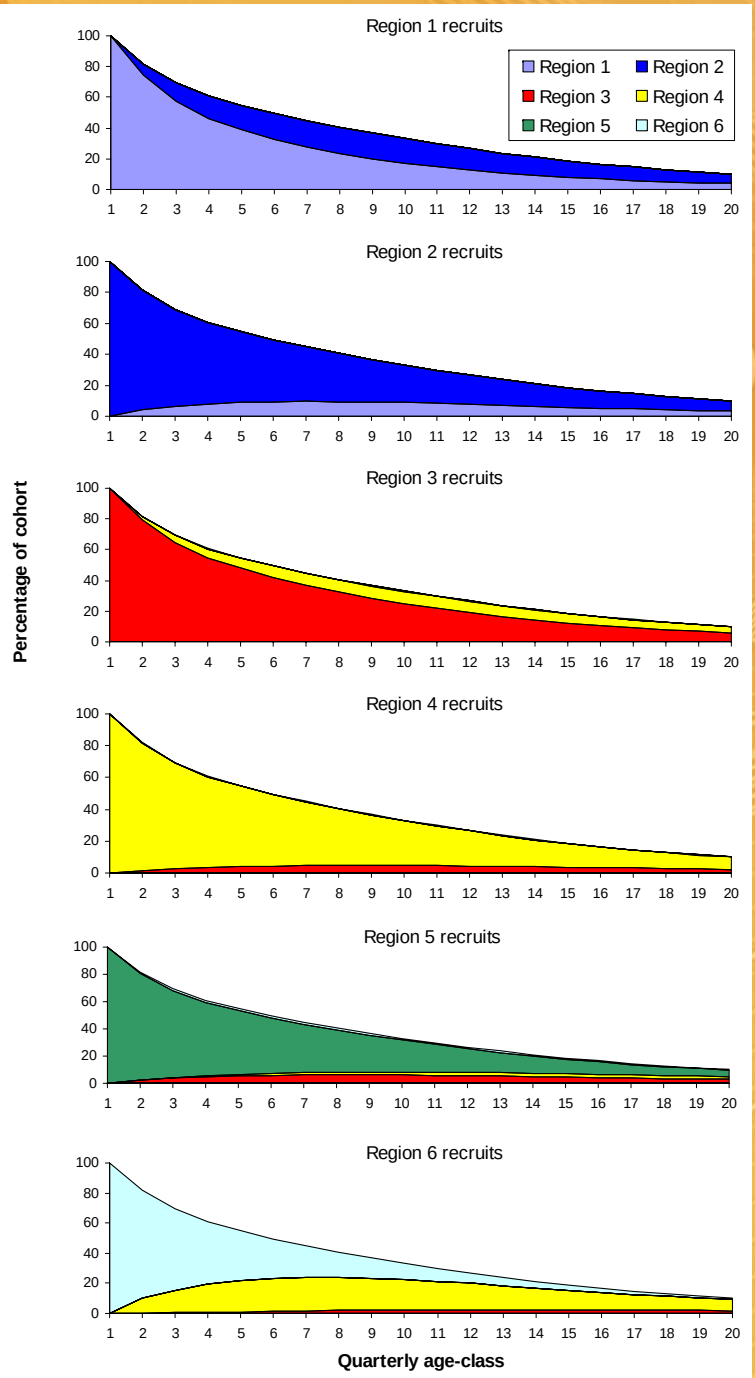
Model Diagnostics

6. Growth Estimates



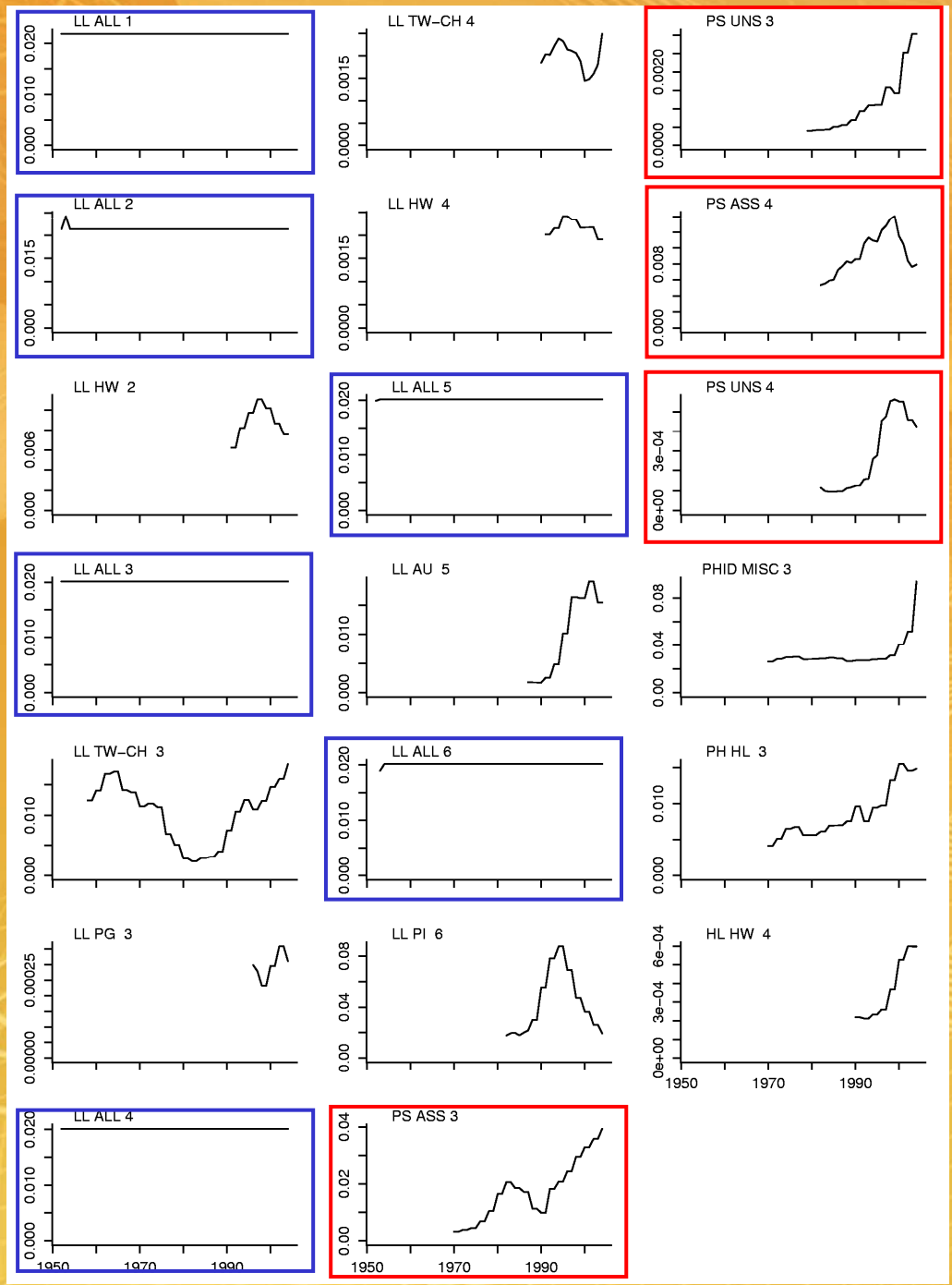
Biological Parameters

Movement Estimates

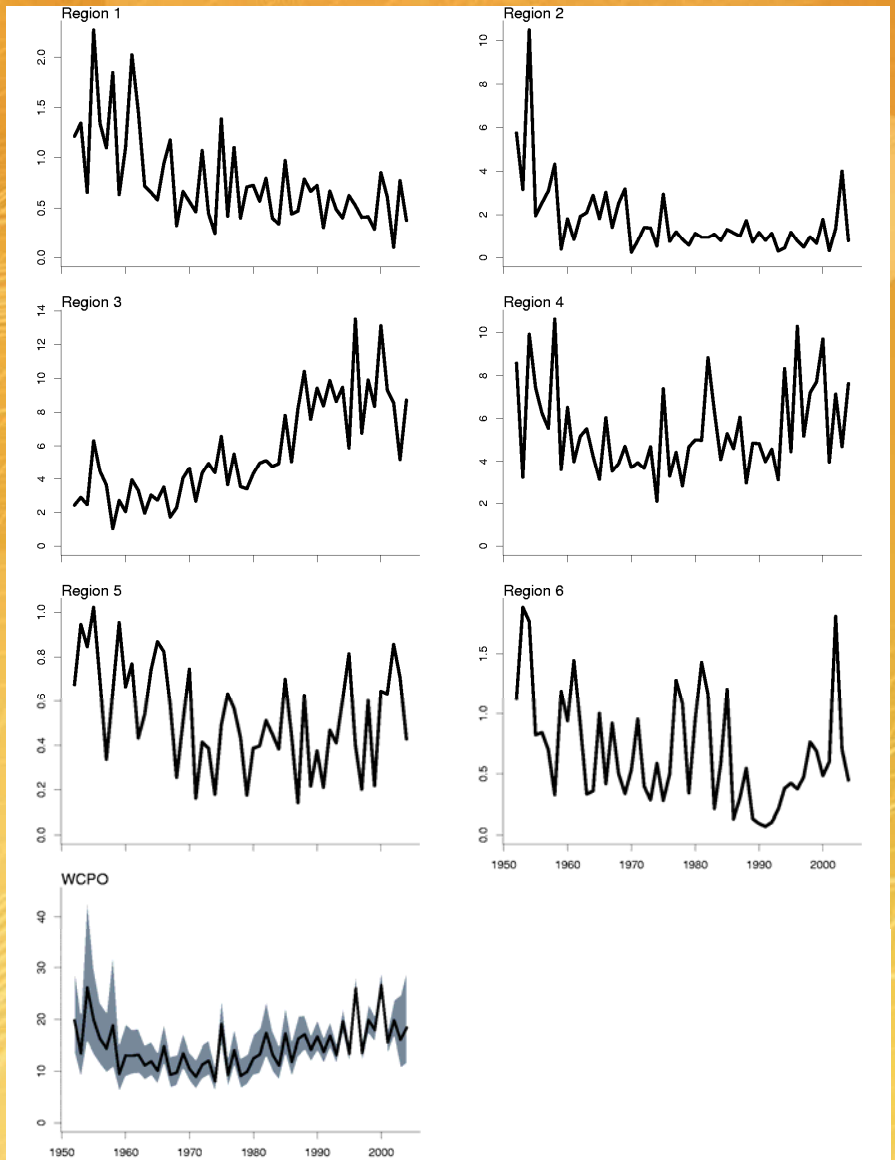


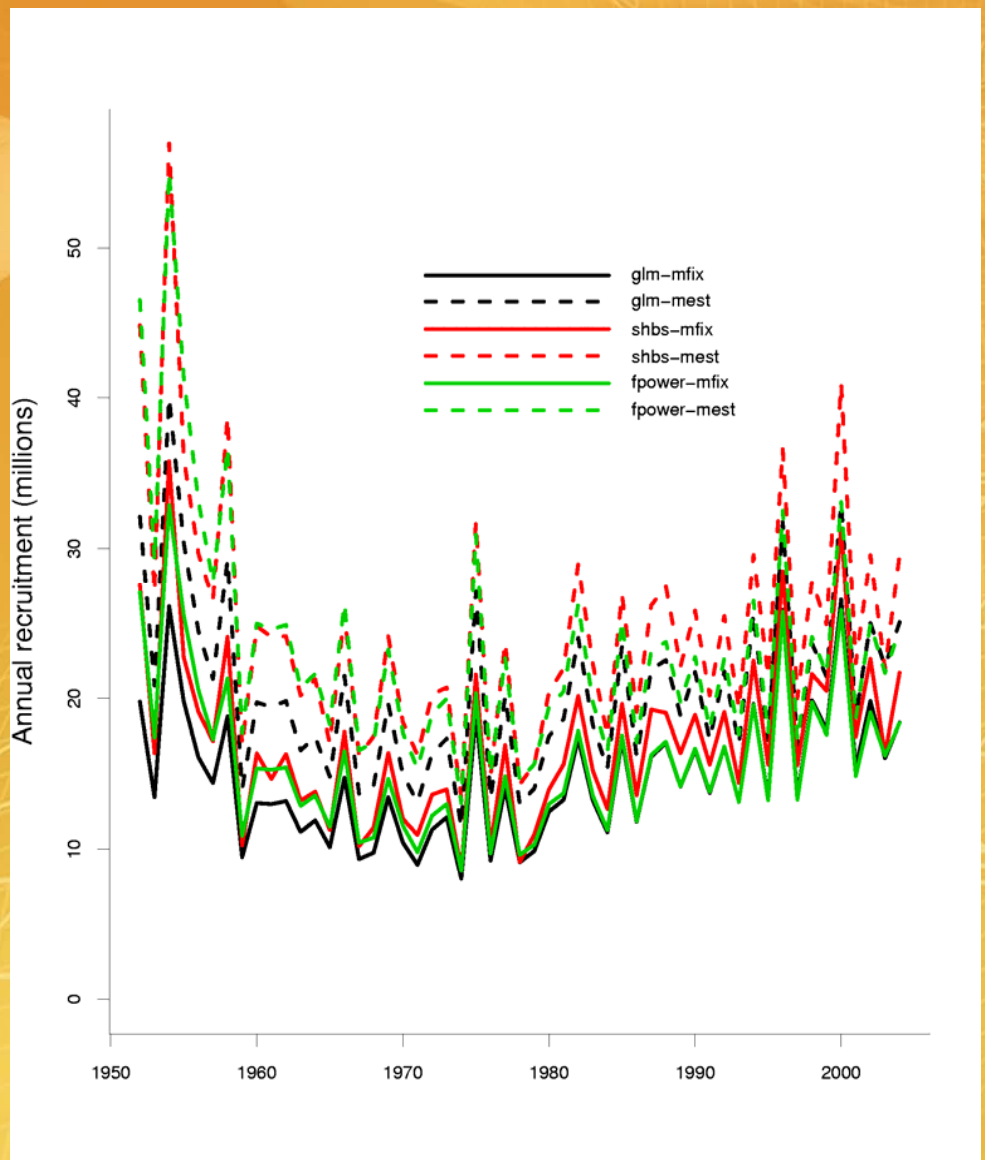
Biological Parameters

Catchability Estimates

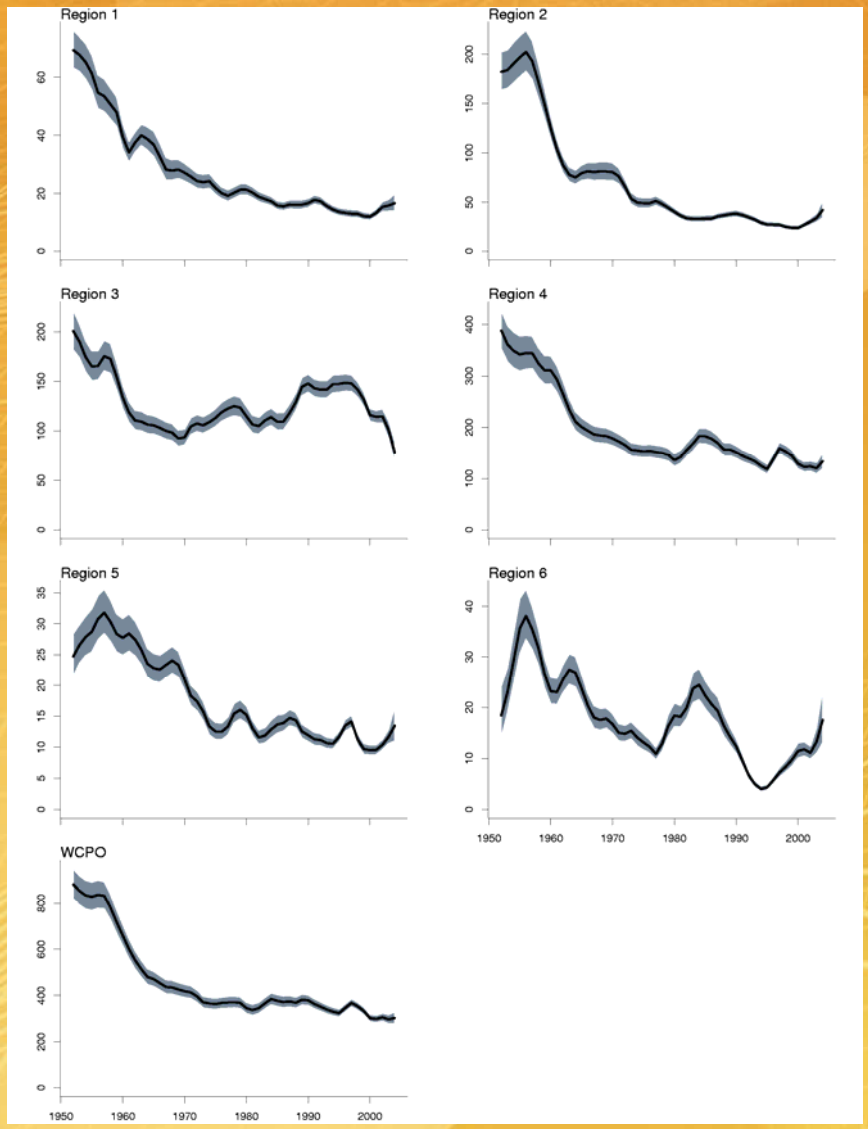


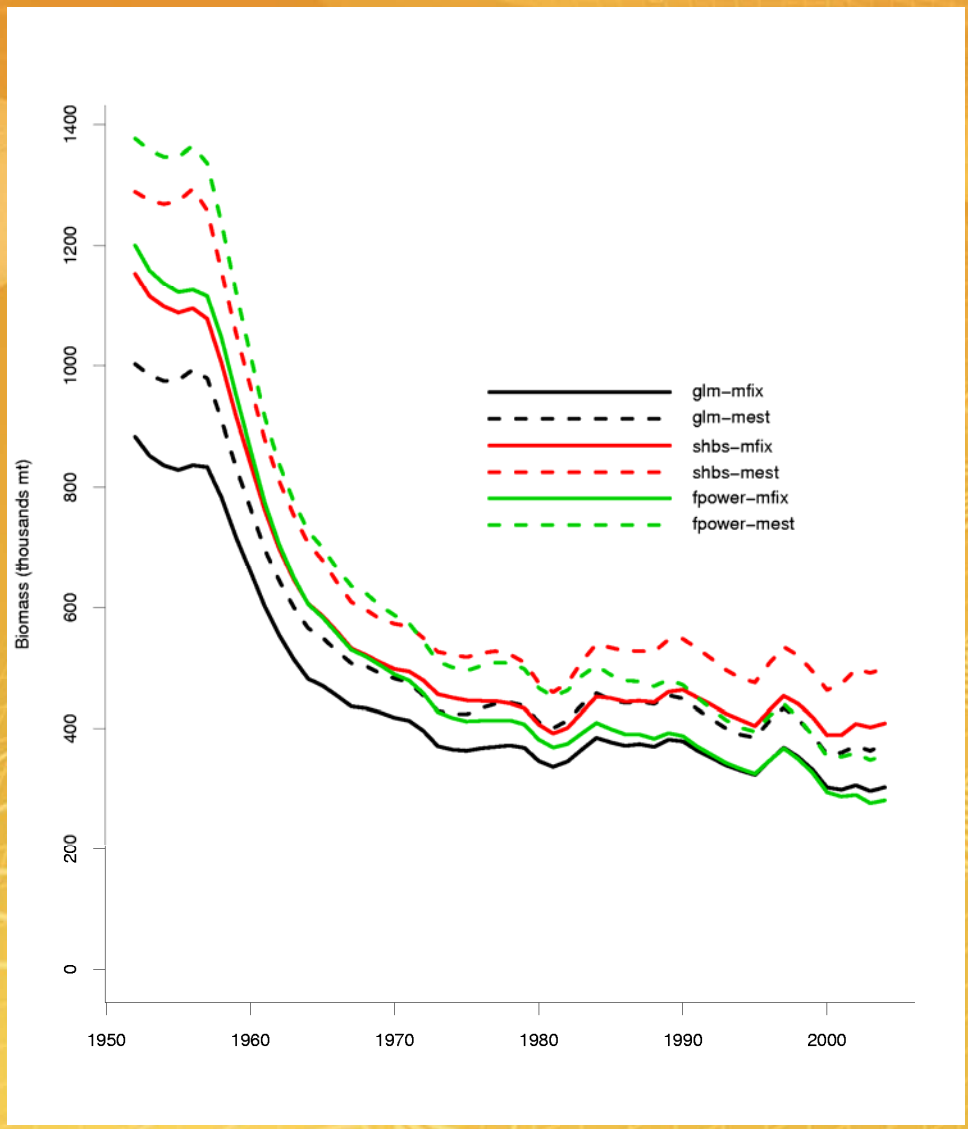
Assessment Results – Recruitment



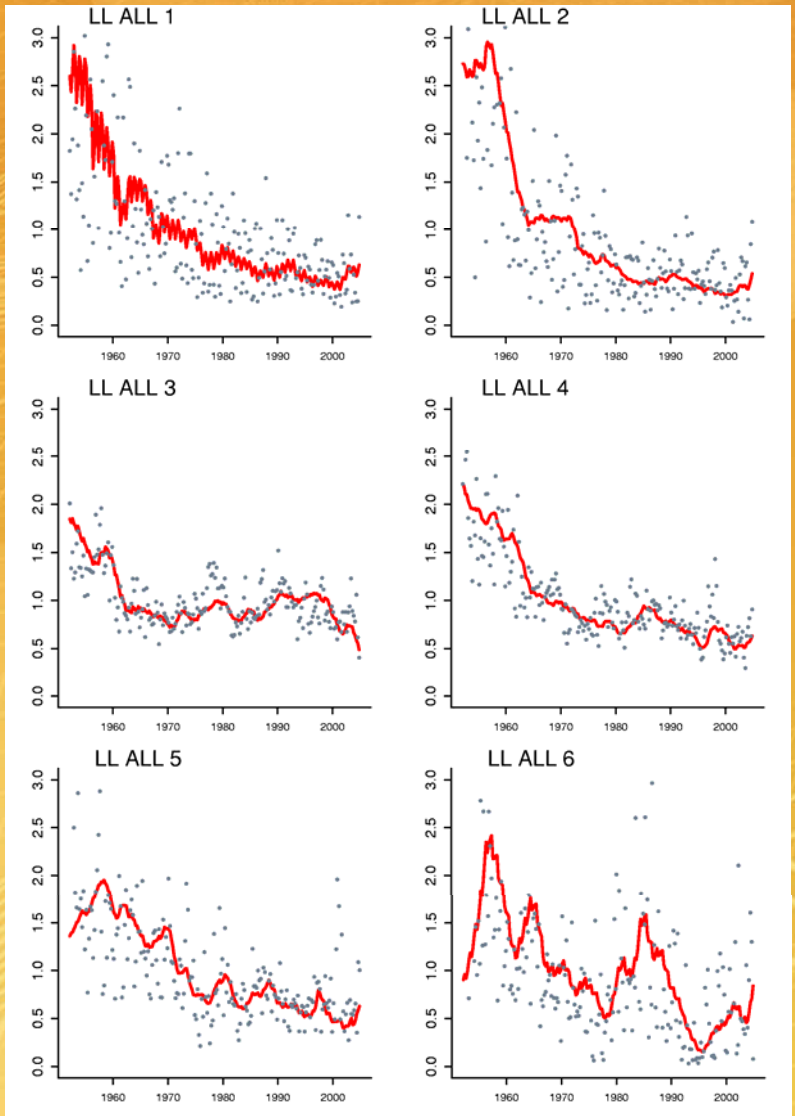


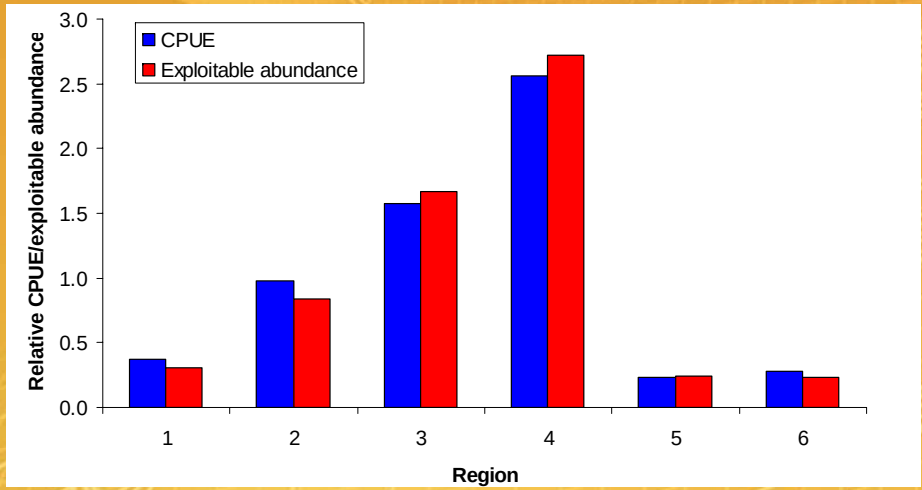
Assessment Results – Biomass



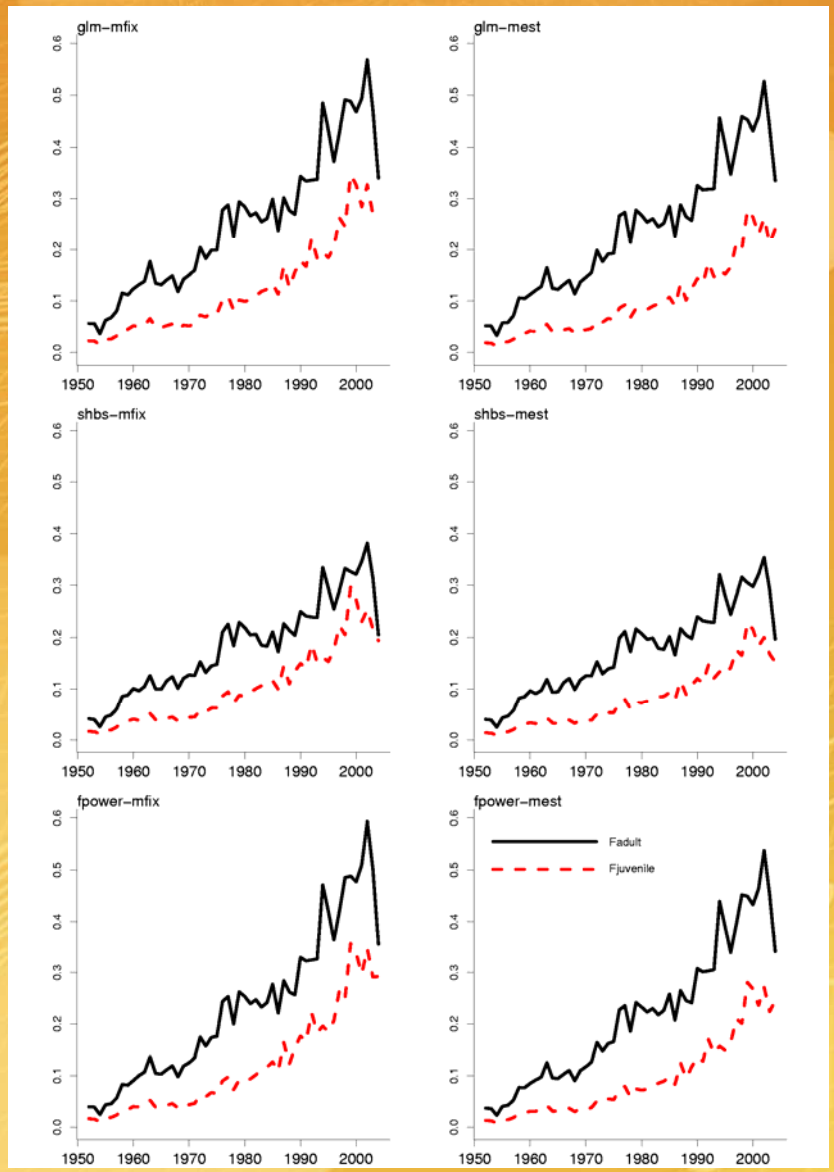


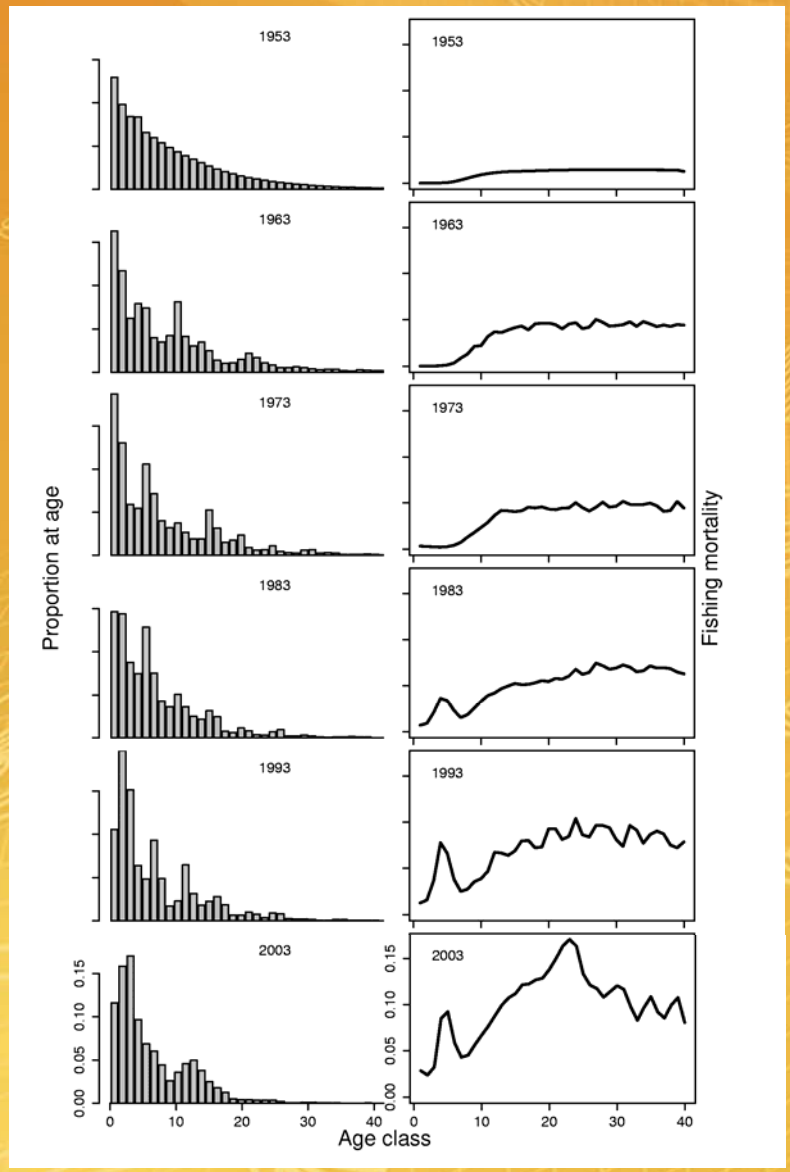
Assessment Results – Biomass



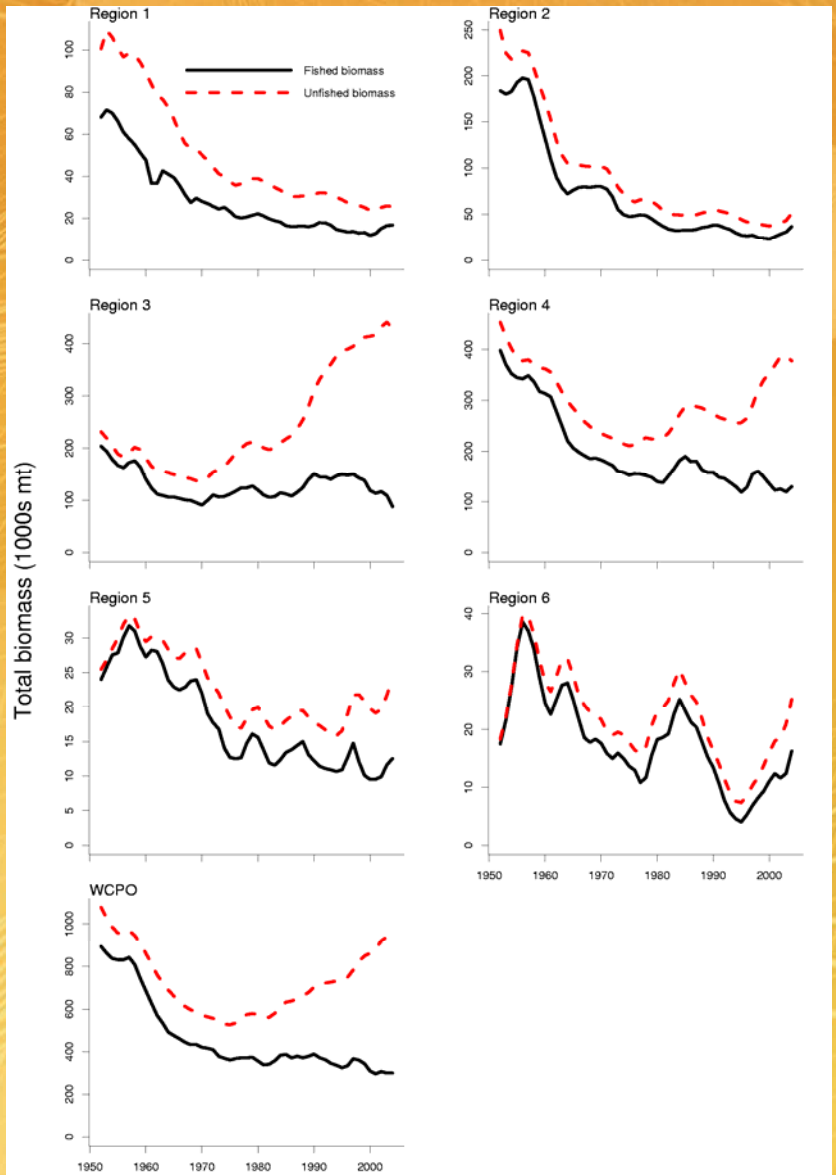


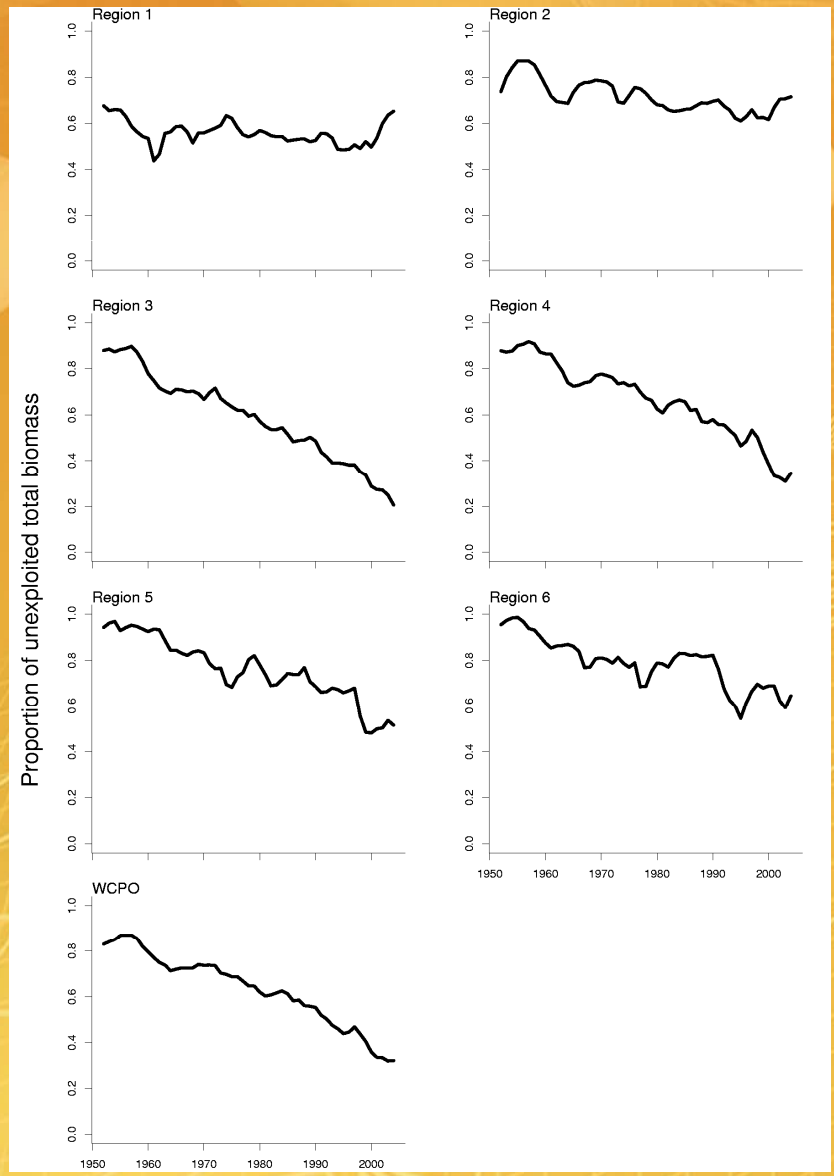
Assessment Results – Fishing Mortality



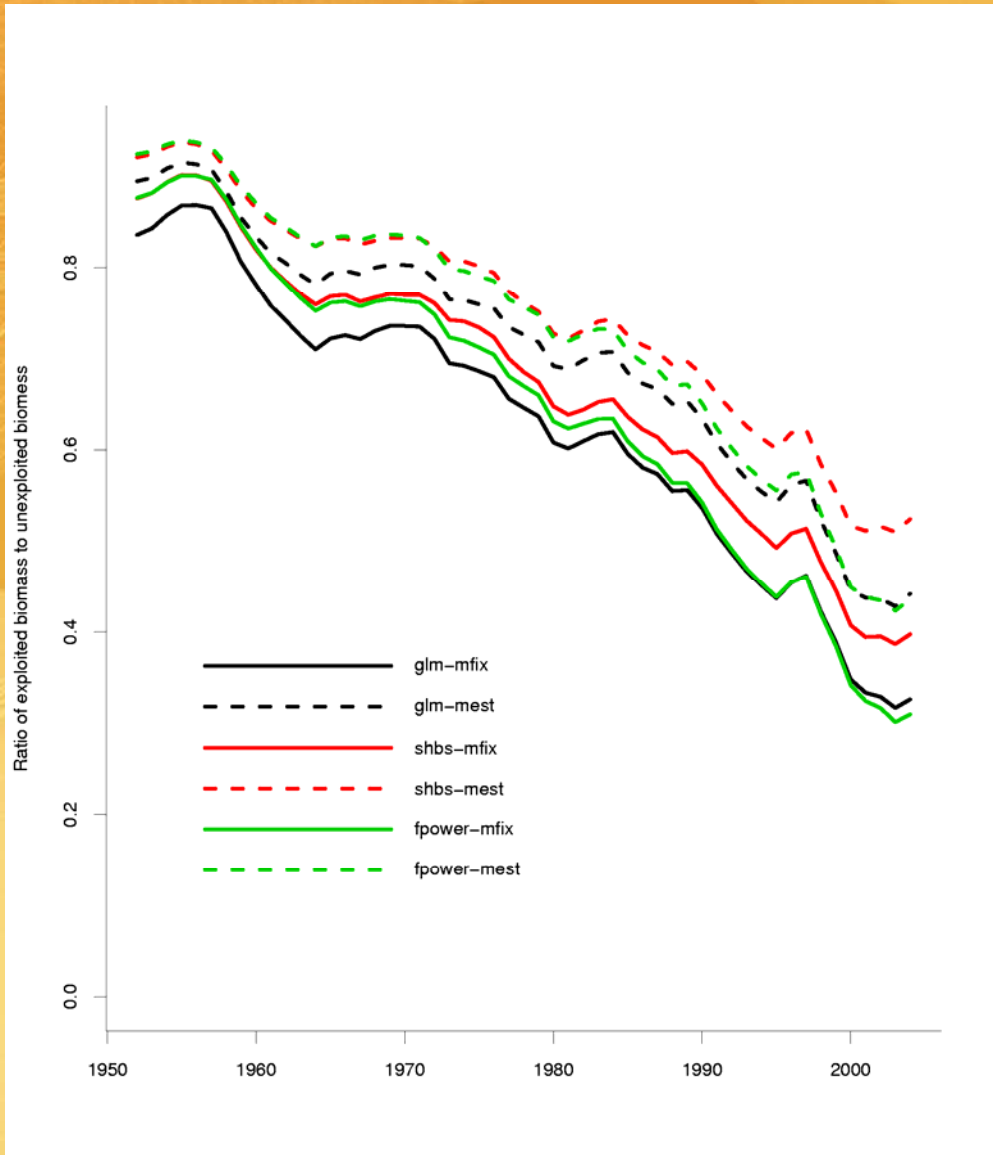


Assessment Results – Fishery Impact



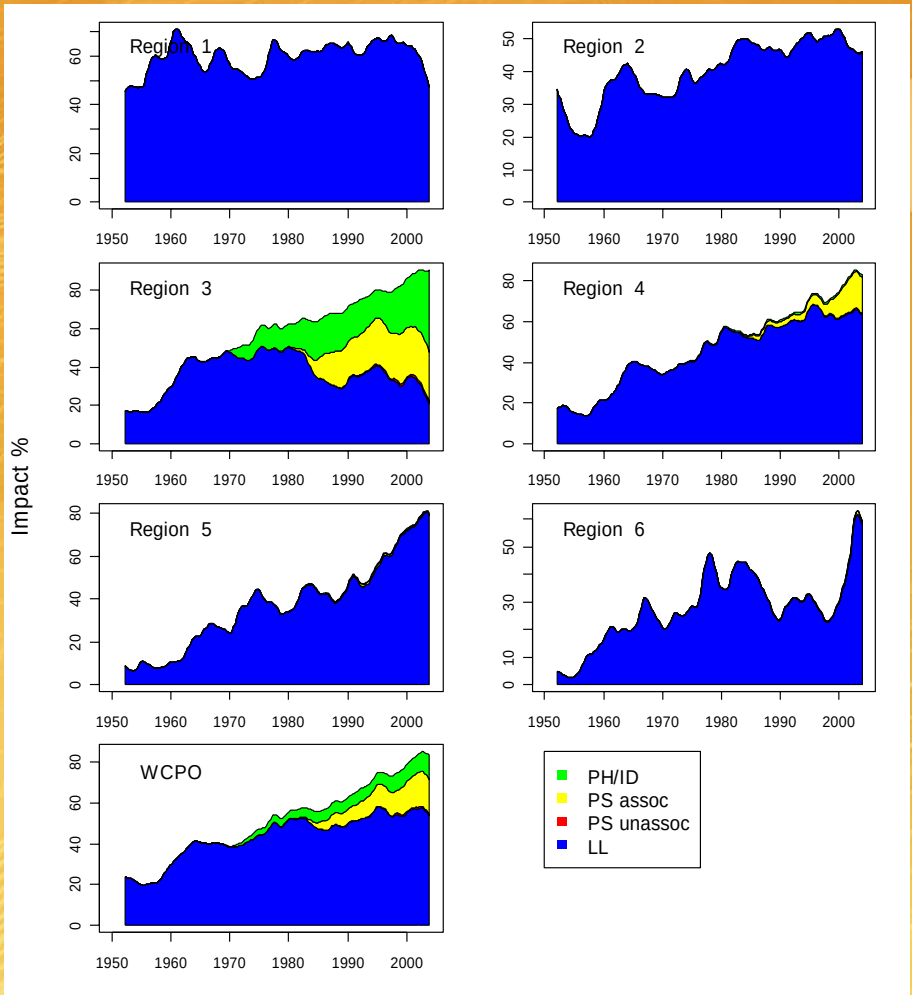


Assessment Results – Fishery Impact

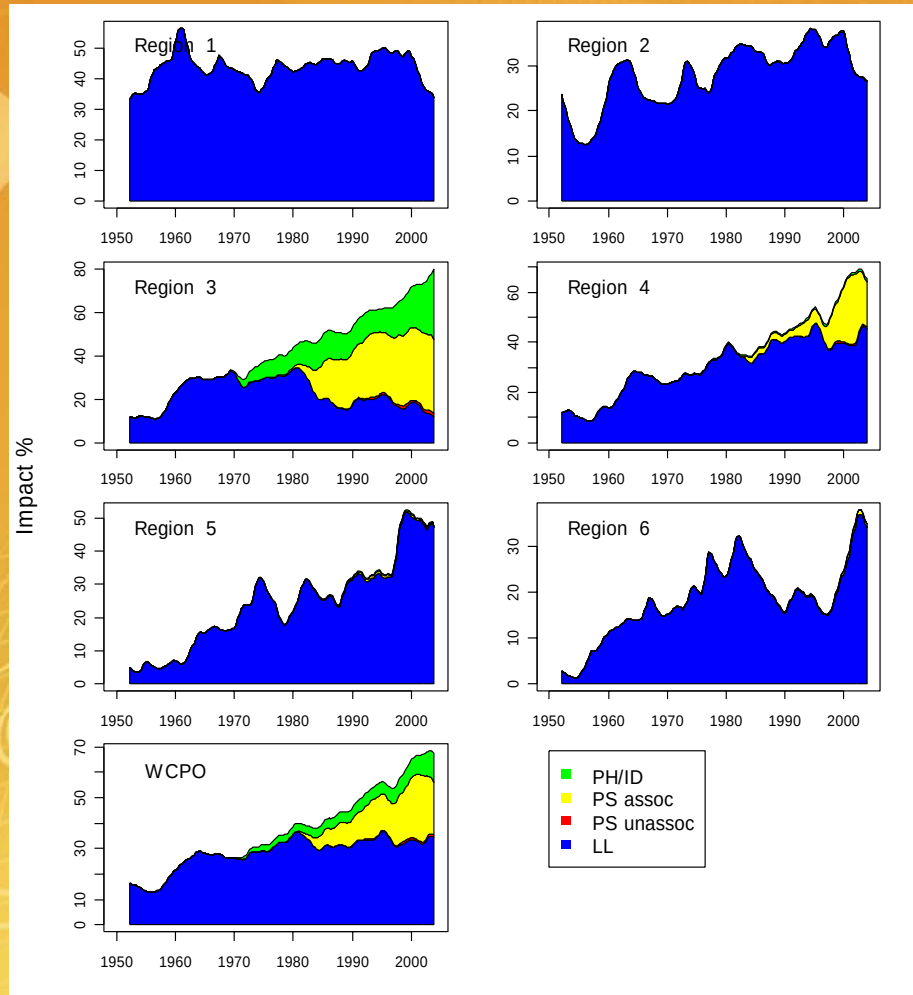


Assessment Results – Fishery Impact

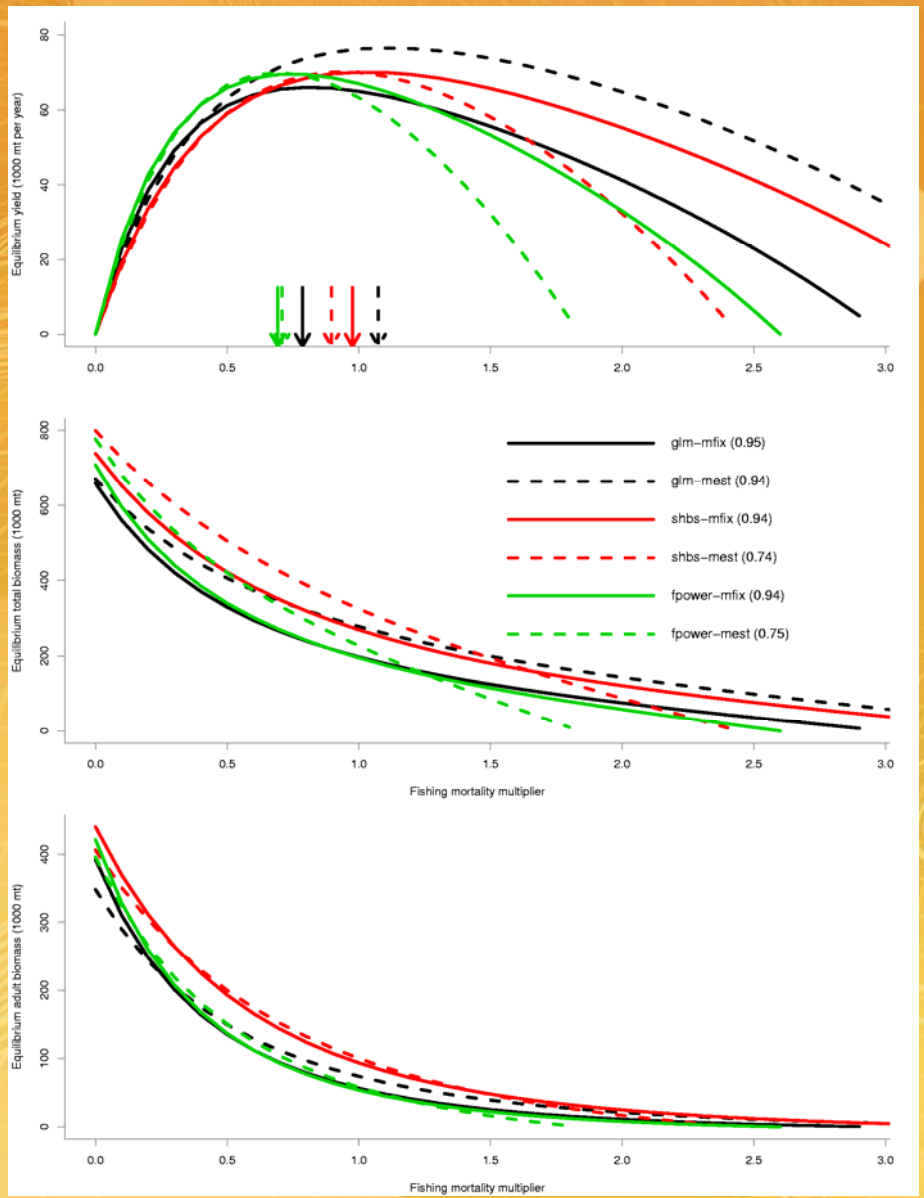
Adult Biomass

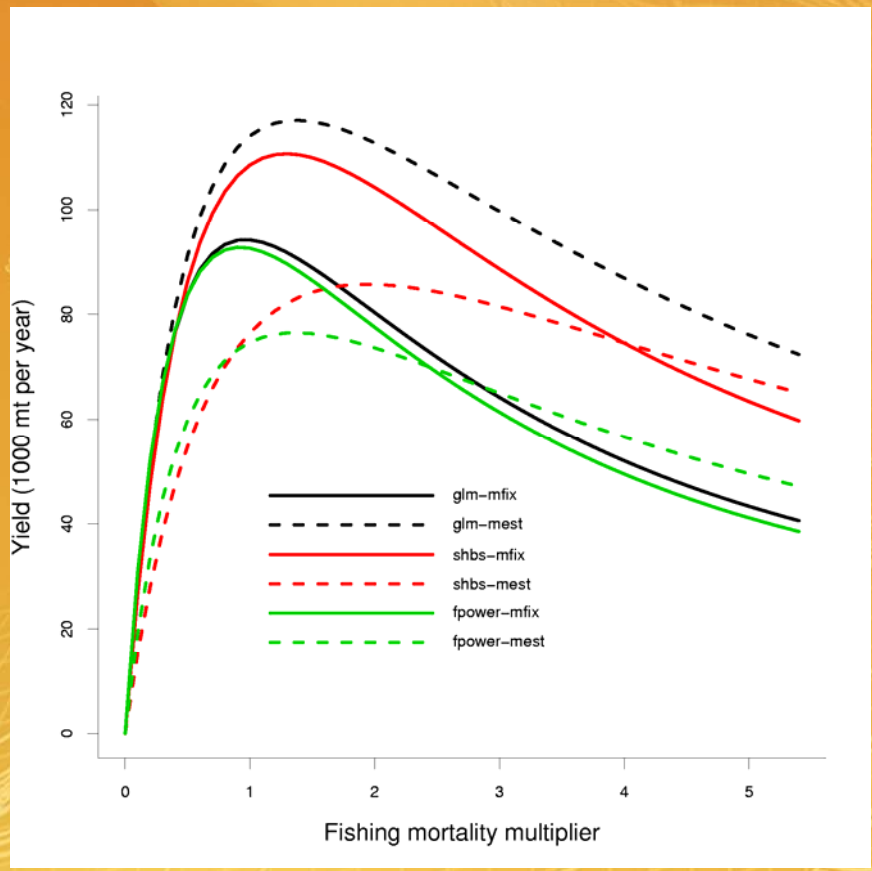


Total Biomass

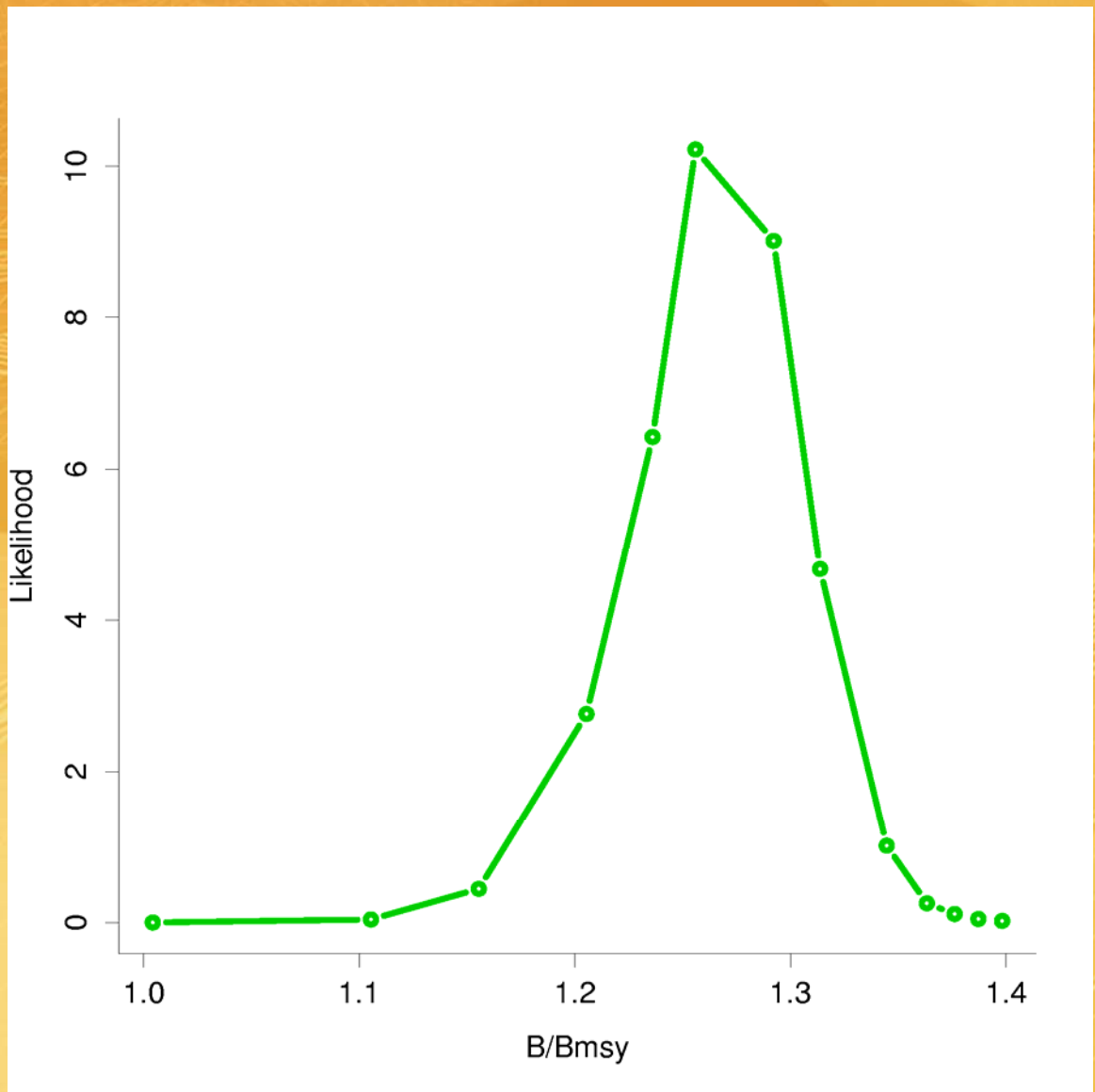


Assessment Results – Yield Analysis





Assessment Results – Yield Analysis



Assessment Results – Yield Analysis

Management quantity	Units	SHBS-MEST	SHBS-MFIX	GLM-MEST	GLM-MFIX	FPOW-MEST	FPOW-MFIX
$\tilde{Y}_{F_{current}}$	t per quarter	17,500	17,520	19,060	16,240	15,800	16,800
$\tilde{Y}_{F_{MSY}}$ (or *MSY*)	t per quarter	17,520	17,520	19,130	16,510	17,490	17,370
$\tilde{B}_0$	t	798,800	738,300	670,300	658,400	776,300	707,600
$\tilde{B}_{F_{current}}$	t	324,600	269,200	277,900	197,400	226,800	195,200
$\tilde{B}_{MSY}$	t	355,400	269,200	259,500	239,500	332,700	269,300
$\tilde{SB}_0$	t	406,300	440,500	348,300	392,600	395,900	421,500
$\tilde{SB}_{F_{current}}$	t	100,100	93,500	73,810	56,290	57,970	53,640
$\tilde{SB}_{MSY}$	t	115,100	93,500	64,730	78,780	103,700	92,710
$B_{current}$	t	487,639	399,529	364,732	300,334	353,531	284,497
$SB_{current}$	t	144,825	136,504	95,885	86,932	91,768	82,143
$B_{current,F=0}$	t	951,542	1,019,768	840,672	920,945	818,593	906,588
$B_{current} / \tilde{B}_0$		0.61	0.54	0.54	0.46	0.46	0.40
$B_{current} / \tilde{B}_{F_{current}}$		1.50	1.48	1.31	1.52	1.56	1.46
$B_{current} / \tilde{B}_{MSY}$		1.37	1.48	1.41	1.25	1.06	1.06
$B_{current} / B_{current,F=0}$		0.51	0.39	0.43	0.33	0.43	0.31
$SB_{current} / \tilde{SB}_0$		0.36	0.31	0.28	0.22	0.23	0.19
$SB_{current} / \tilde{SB}_{F_{current}}$		1.45	1.46	1.30	1.54	1.58	1.53
$SB_{current} / \tilde{SB}_{MSY}$		1.26	1.46	1.48	1.10	0.88	0.89
$\tilde{B}_{F_{current}} / \tilde{B}_0$		0.41	0.36	0.41	0.30	0.29	0.28
$\tilde{SB}_{F_{current}} / \tilde{SB}_0$		0.25	0.21	0.21	0.14	0.15	0.13
$\tilde{B}_{MSY} / \tilde{B}_0$		0.44	0.36	0.39	0.36	0.43	0.38
$\tilde{SB}_{MSY} / \tilde{SB}_0$		0.28	0.21	0.19	0.20	0.26	0.22
$F_{current} / \tilde{F}_{MSY}$		1.06	0.97	0.90	1.23	1.45	1.35
$\tilde{B}_{F_{current}} / \tilde{B}_{MSY}$		0.91	1.00	1.07	0.82	0.68	0.72
$\tilde{SB}_{F_{current}} / \tilde{SB}_{MSY}$		0.87	1.00	1.14	0.71	0.56	0.58
$\tilde{Y}_{F_{current}} / MSY$		1.00	1.00	1.00	0.98	0.90	0.97

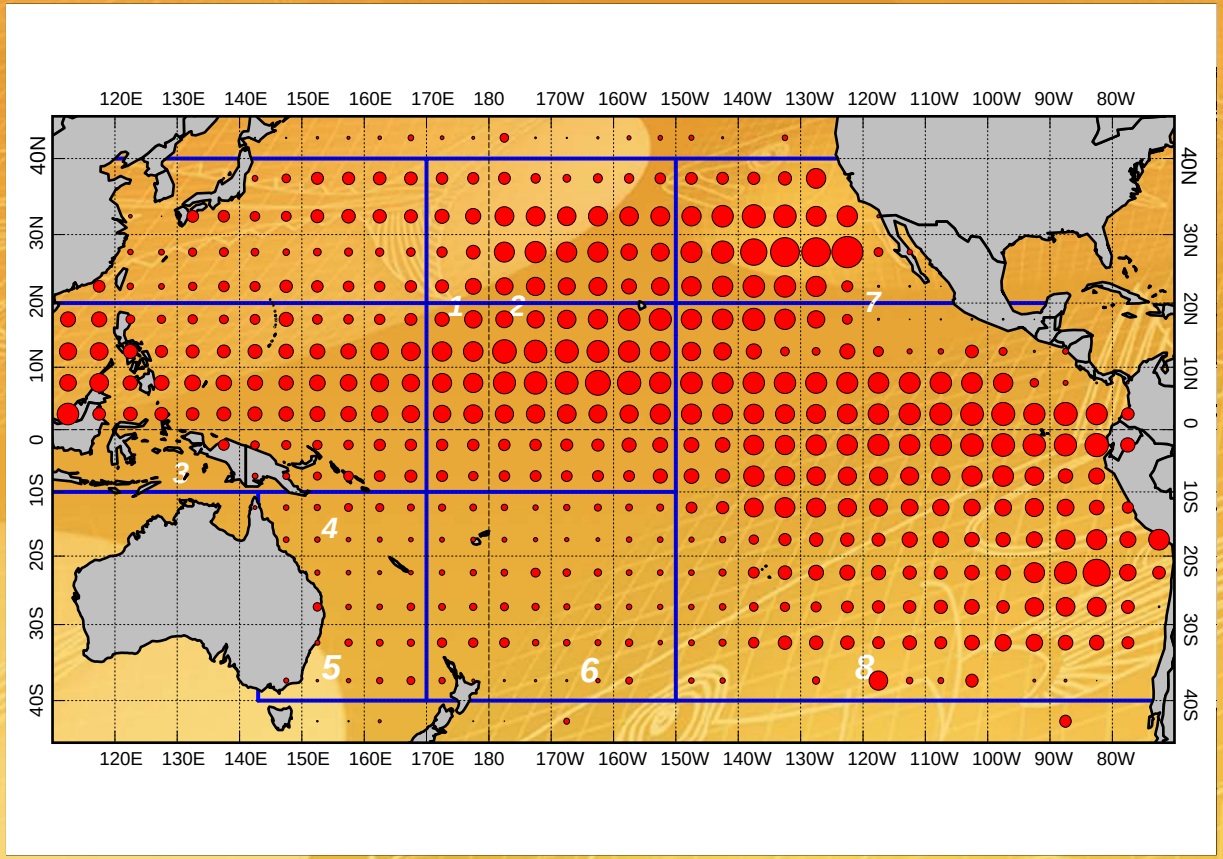
Main Conclusions

- Recruitment in all analyses increased since about 1980
- Biomass declined to about half of its initial level by 1970 and has been fairly stable or subject to slight decline since then
- Biomass is currently 0.31-0.51 of unexploited levels.
- Depletion more severe in tropical regions
- Longline fishery has highest overall impact, but surface fisheries also have high impact in tropical regions
- Recent fishing mortality is near to or above the MSY level, i.e. it is likely that overfishing is occurring
- Current biomass is above MSY levels, but adult biomass is below MSY levels for the FPOW analyses
- Biomass is predicted to fall below MSY levels at current effort levels unless recruitment remains above average

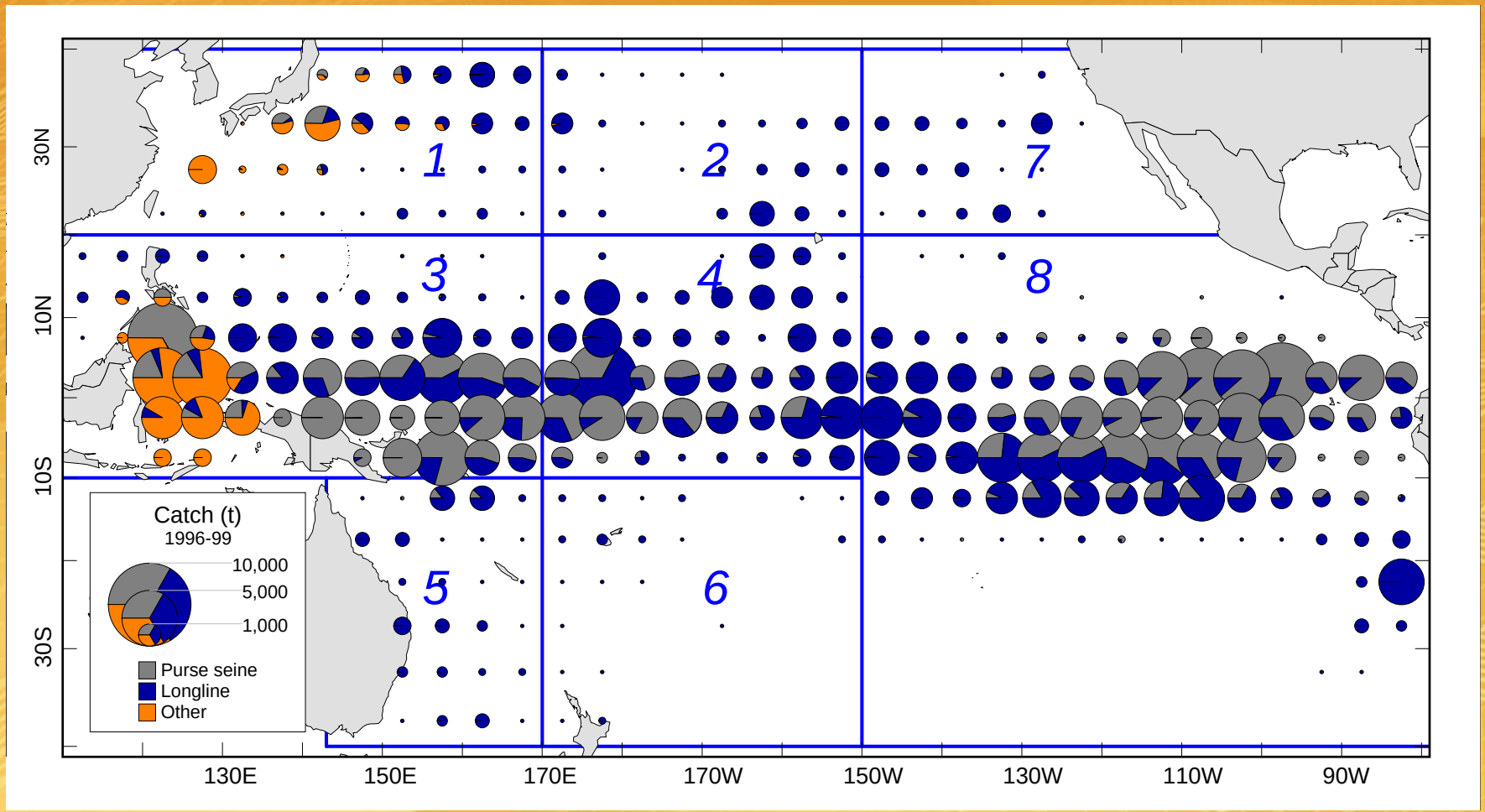
PO-WCPO-EPO Comparisons

- Comparisons use SHBS longline effort
- Compare WCPO/PO results from MFCL models
- Compare EPO/PO results using A-SCALA (EPO) and MFCL (PO)

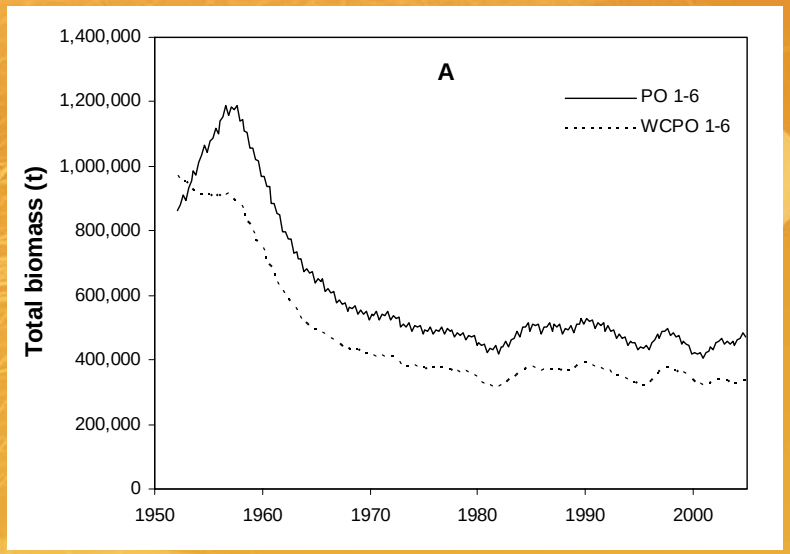
PO Bigeye Model

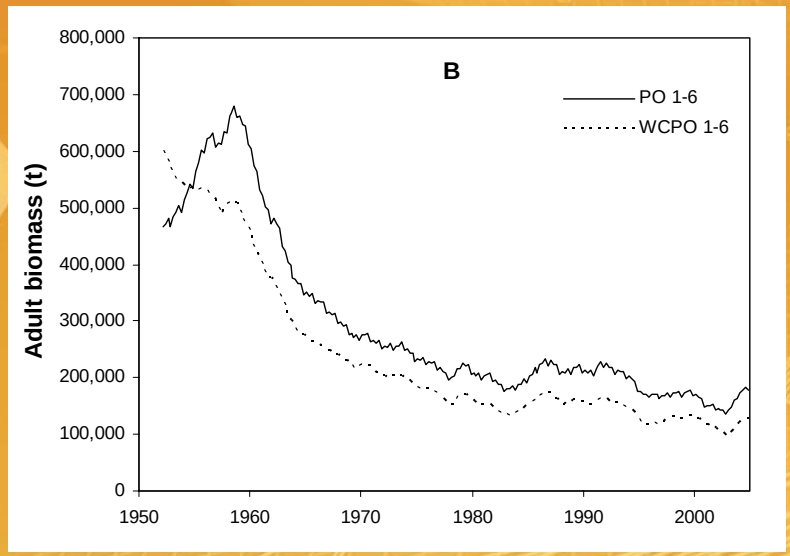


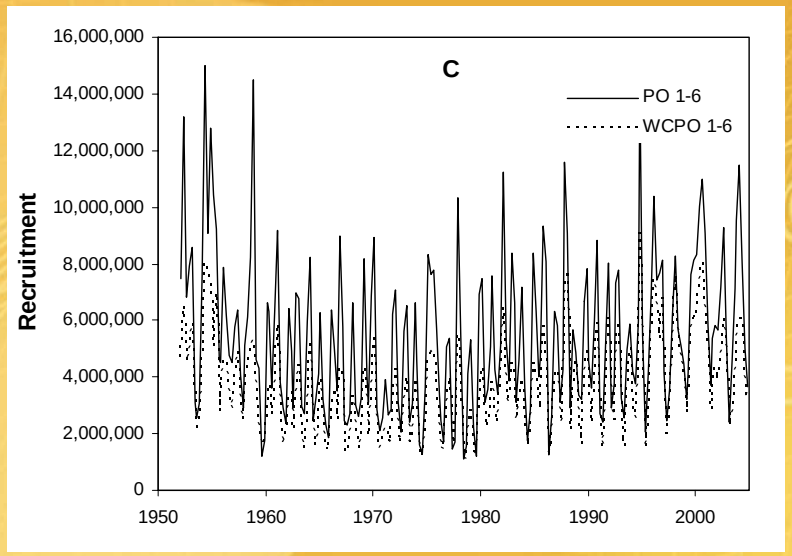
PO Bigeye Model

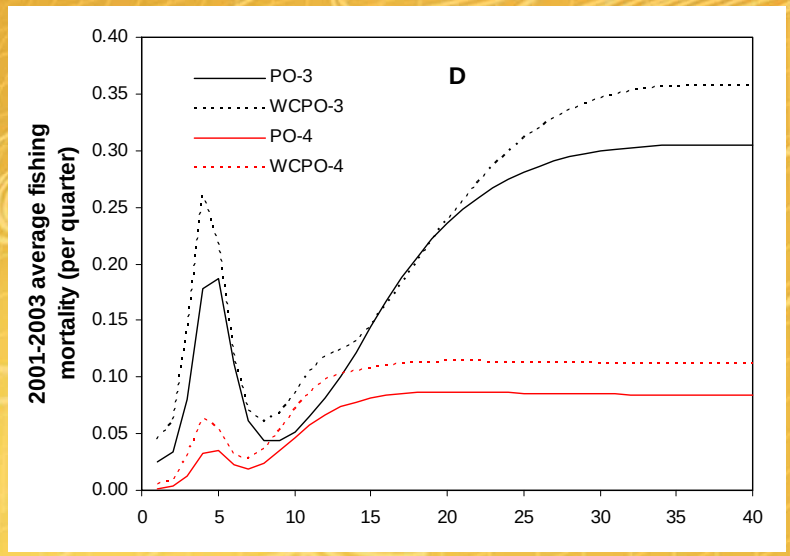


WCPO-PO Comparisons (1)

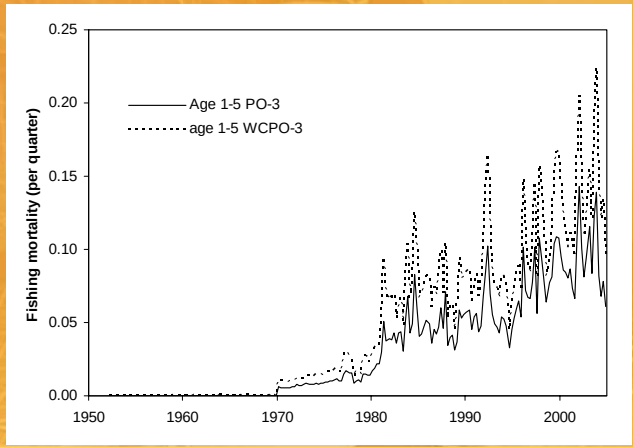


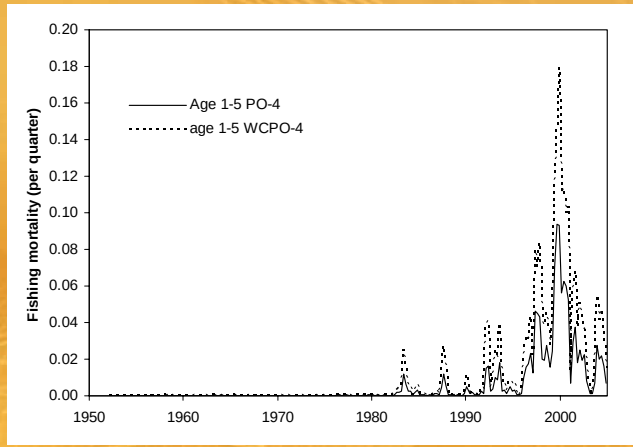


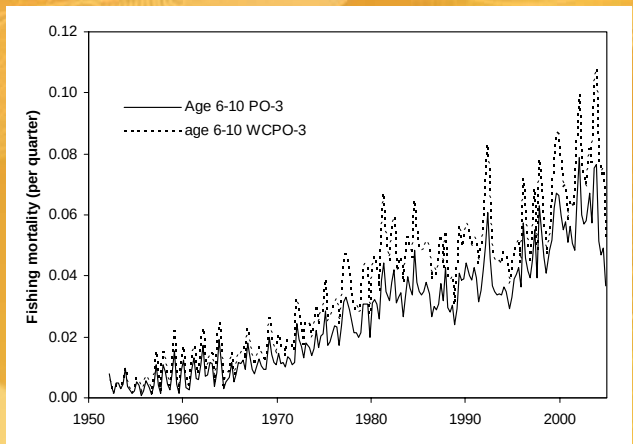


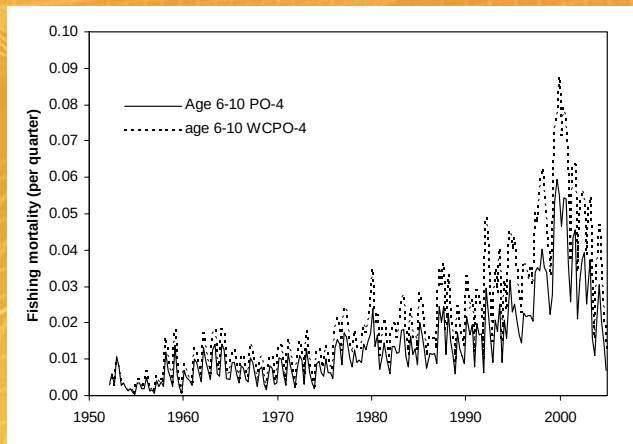


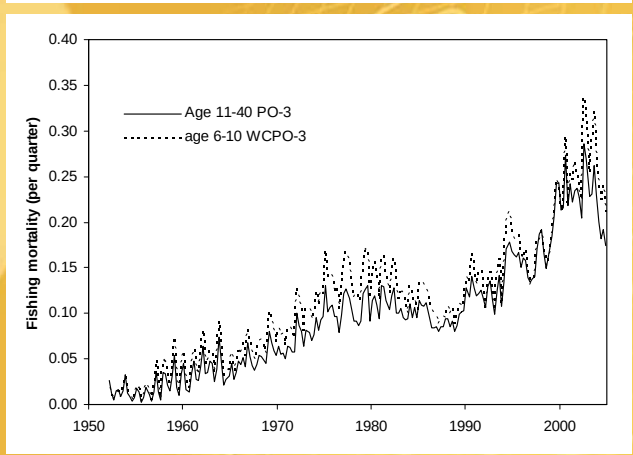
WCPO-PO Comparisons (2)

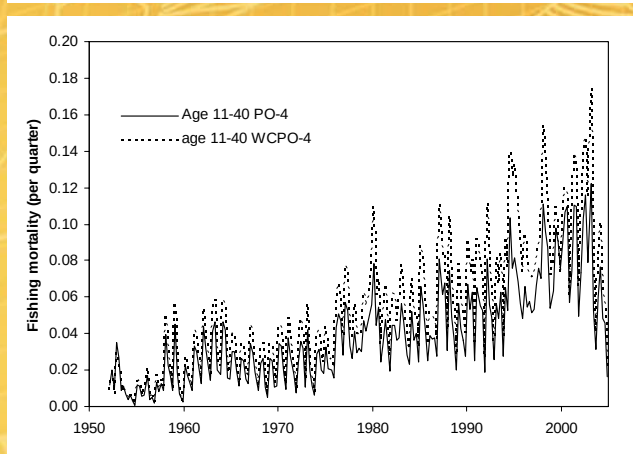




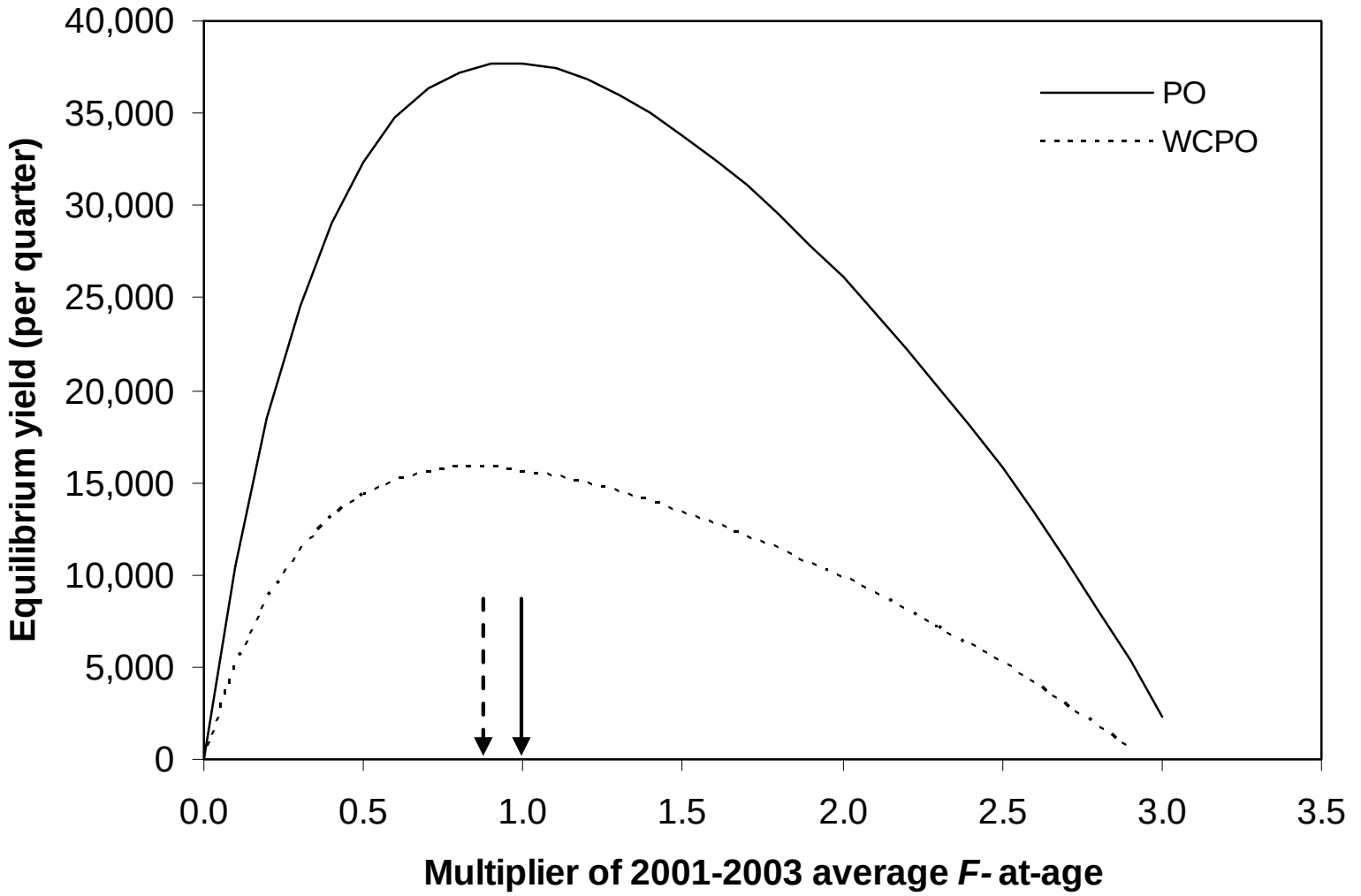




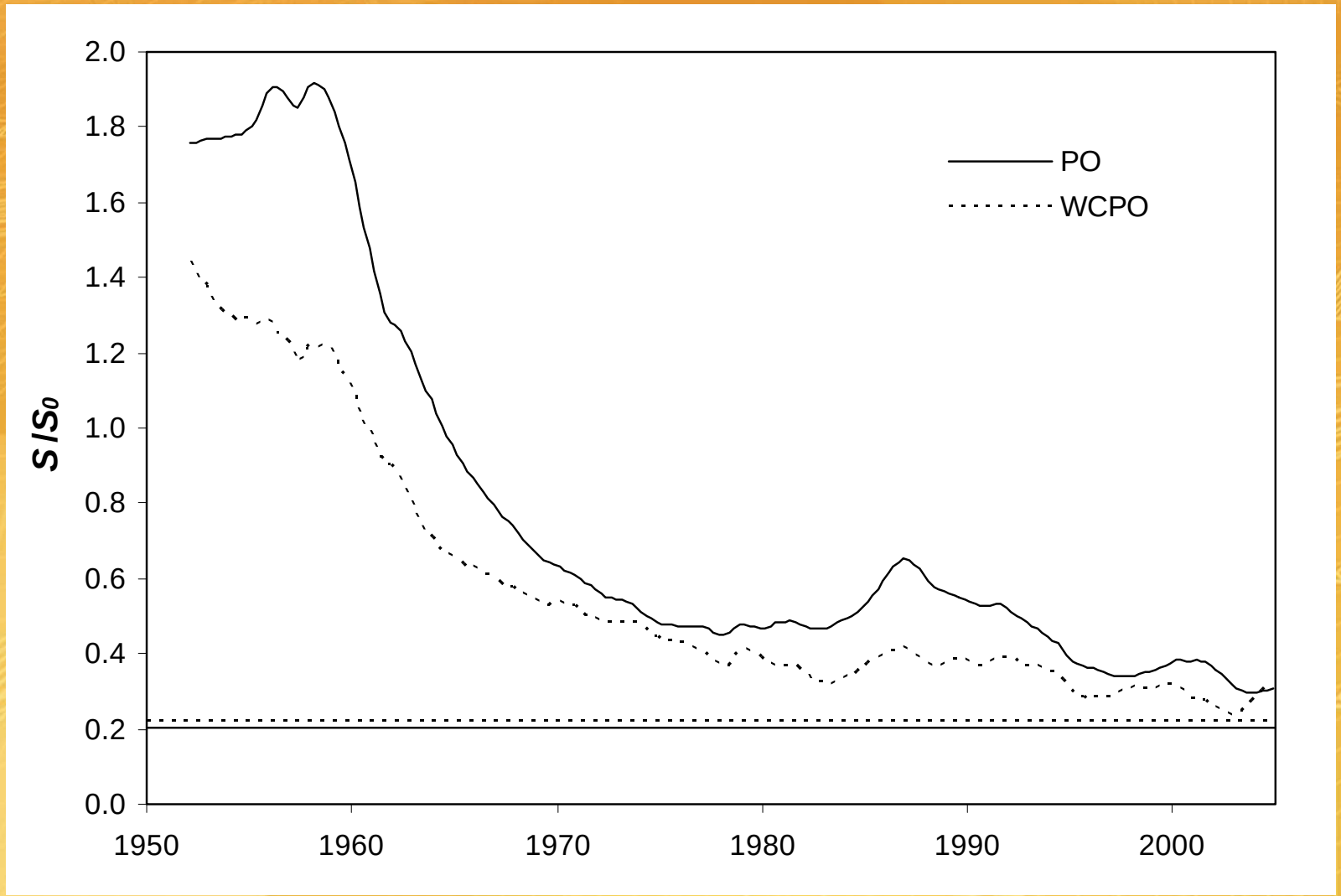




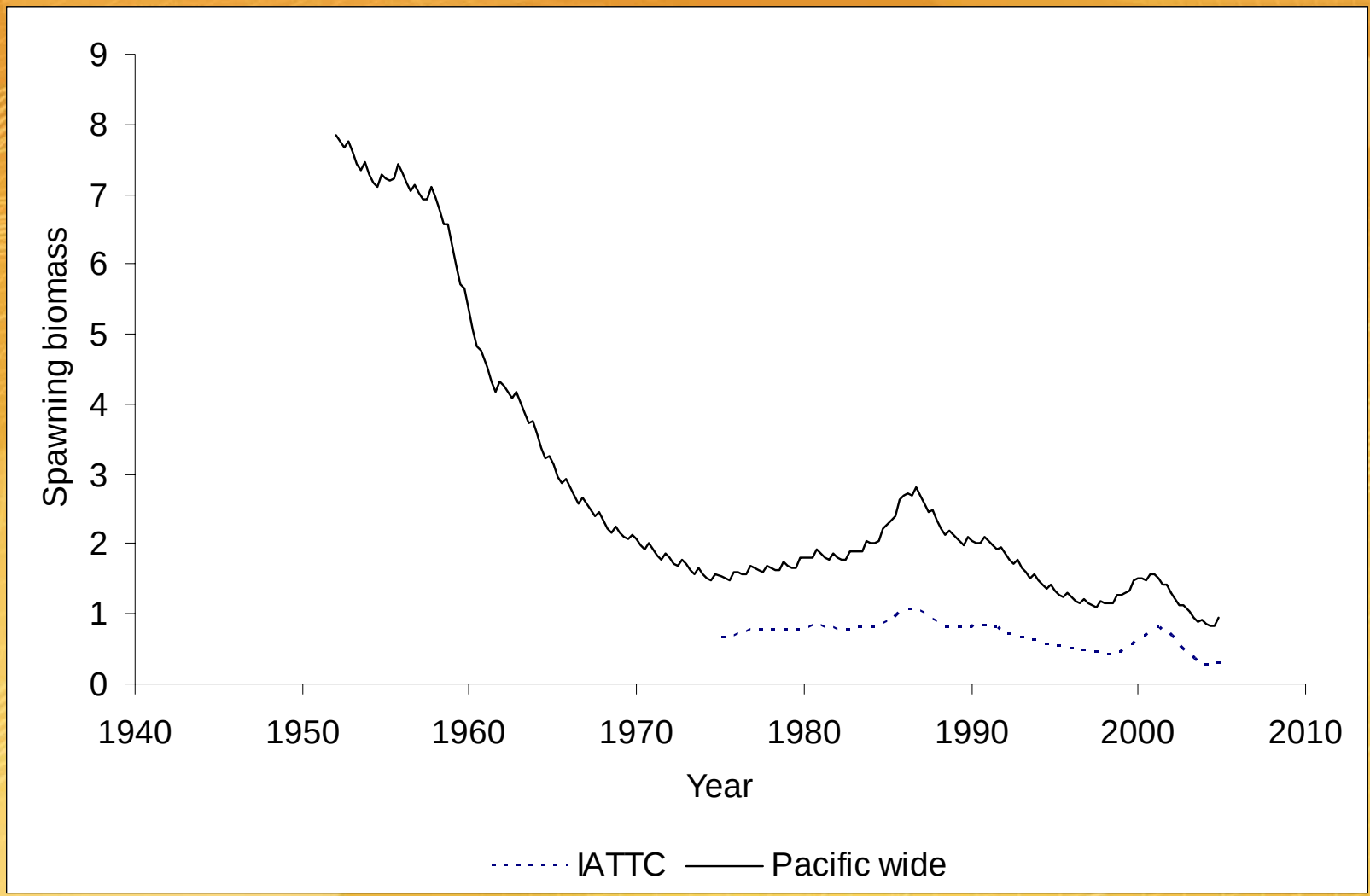
WCPO-PO Comparisons (3)



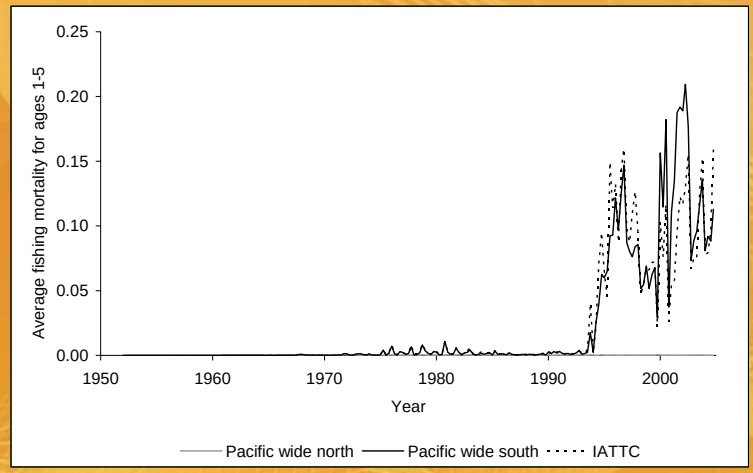
WCPO-PO Comparisons (4)

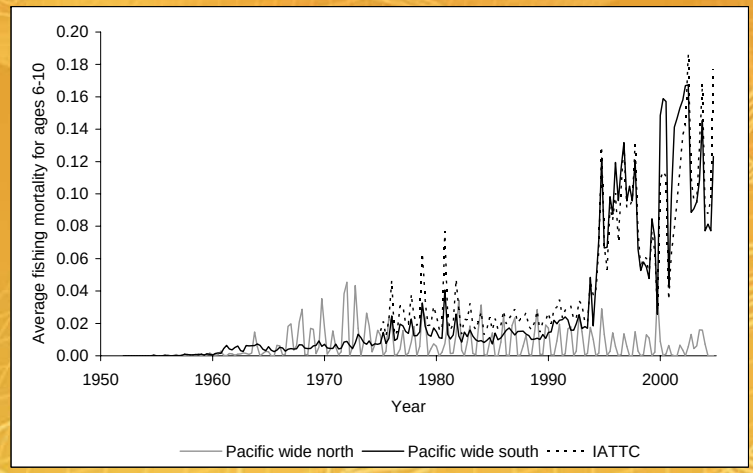


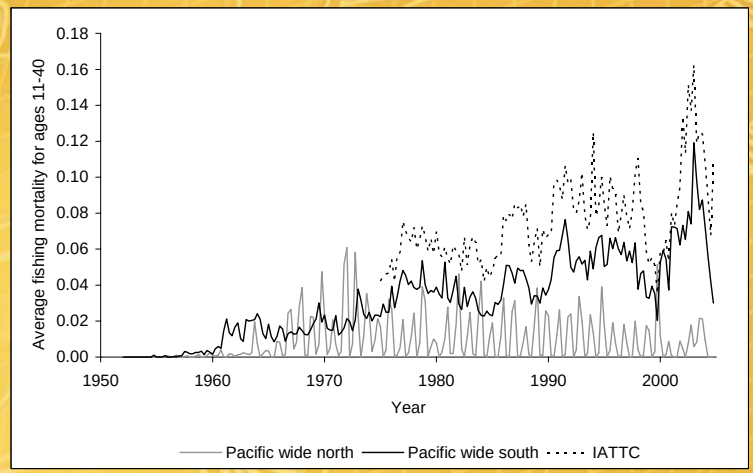
EPO-PO Comparisons (1)



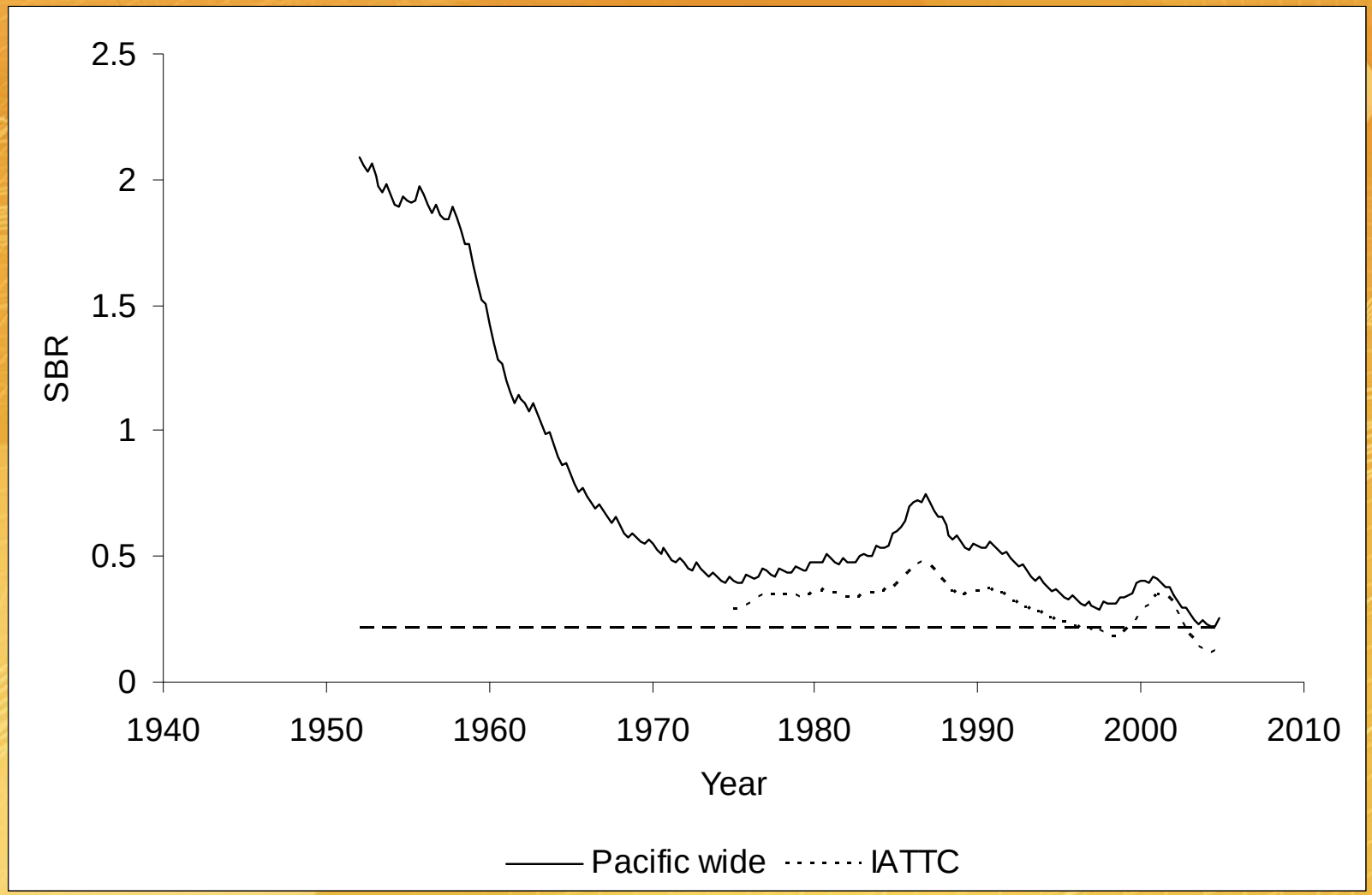
EPO-PO Comparisons (2)







EPO/PO Comparisons (3)



Growth Estimates