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STOCK ASSESSMENT OF SOUTH PACIFIC ALBACORE TUNA

WCPFC-SC14-2018/SA-WP-05

Tremblay-Boyer L, Hampton J, McKechnie S and Pilling G

14th Regular Session of the Scientific Committee
Busan, Republic of Korea
August 8th-16th

MFCL assessment cheatsheet

Inputs

Catch*

Size composition*
(length LL)

CPUEs*

Tagging*
(if available)

Age-length*

Process

1. Stepwise development from last assessment

Incl. new features and adjustments to obtain satisfactory model diagnostics

↓

DIAGNOSTIC CASE

2. One-off sensitivities (biological and model)

Outputs

- **Model diagnostics**
- **Key model predictions**

(spawning potential; recruitment; depletion by region, etc.)

Data inputs described in SC14/SA-IP-07

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3. STRUCTURAL UNCERTAINTY GRID
(based on key sensitivities)

Outputs

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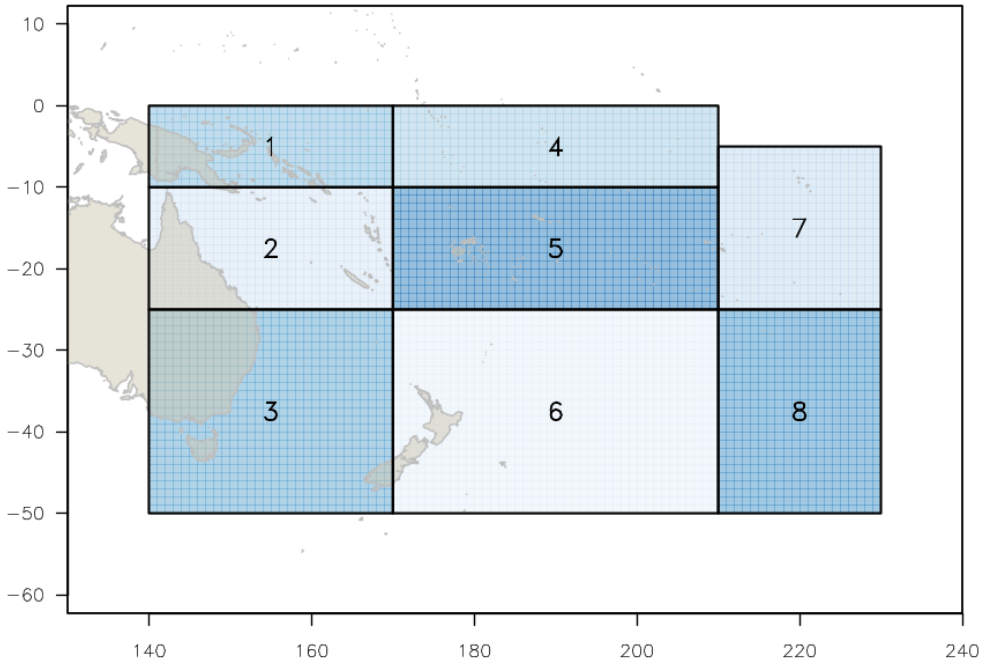
Reference points aggregated across grid model runs

OVERVIEW

- 2015 assessment
- Key changes from the 2015 assessment
- Data inputs
- Stepwise from 2015 to the diagnostic case
- Diagnostics
- Structural uncertainty grid
- Challenges in the current assessment

2015 ASSESSMENT

- Inclusion of age-length data (from CSIRO otoliths)
- Moved from a single region model (2012) to an 8 region model
- “Reference/base case” model was used to represent stock status
- Uncertainty grid of 18 models was used to characterise uncertainty.



DEVELOPMENT OF THE 2018 ASSESSMENT

- 3 more years of data – full access to operational data (inc. JP)

  Time-span: 1960-2016 (i.e. high 2017 catches not included)

- Simplified region structure (8 → 5 regions)

  re: little information on east-west movement

- Longline fisheries partially split by flag
- Addition of Index fisheries
- Move from "traditional" to "geostatistical" CPUE
- CPUE includes Japanese data + no filter on targeting clusters
- More realistic recruitment distributions → Southern regions
- Maturity at length updated with sex ratio + new MFCL feature

See WCPFC-SC-14/SA-IP-07

REGIONAL STRUCTURES

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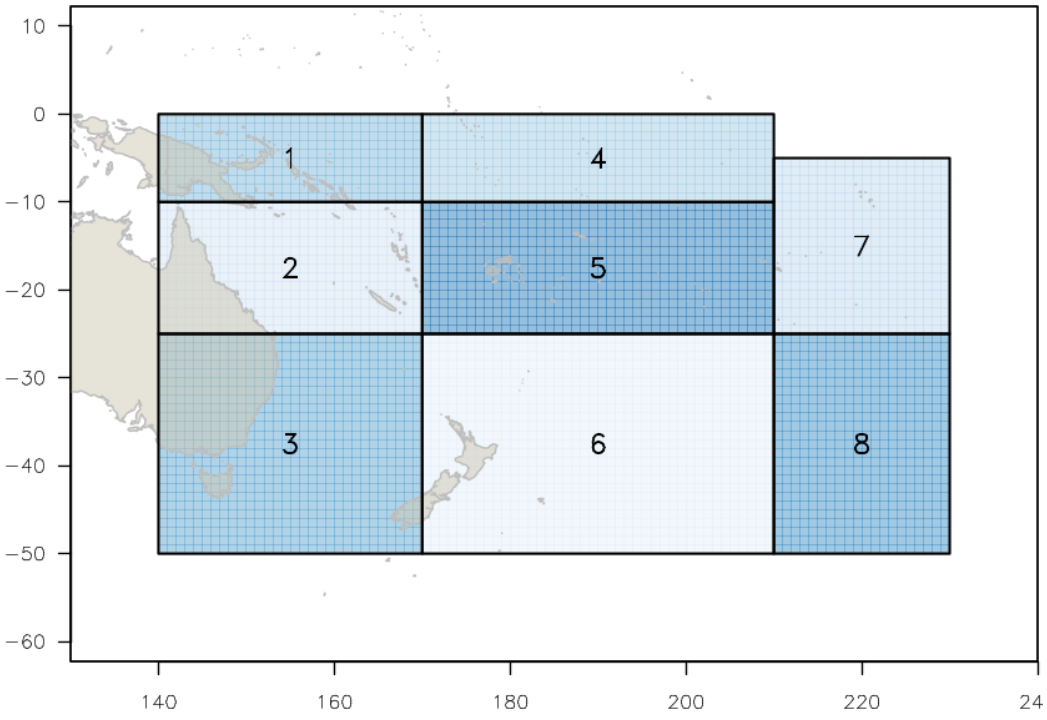
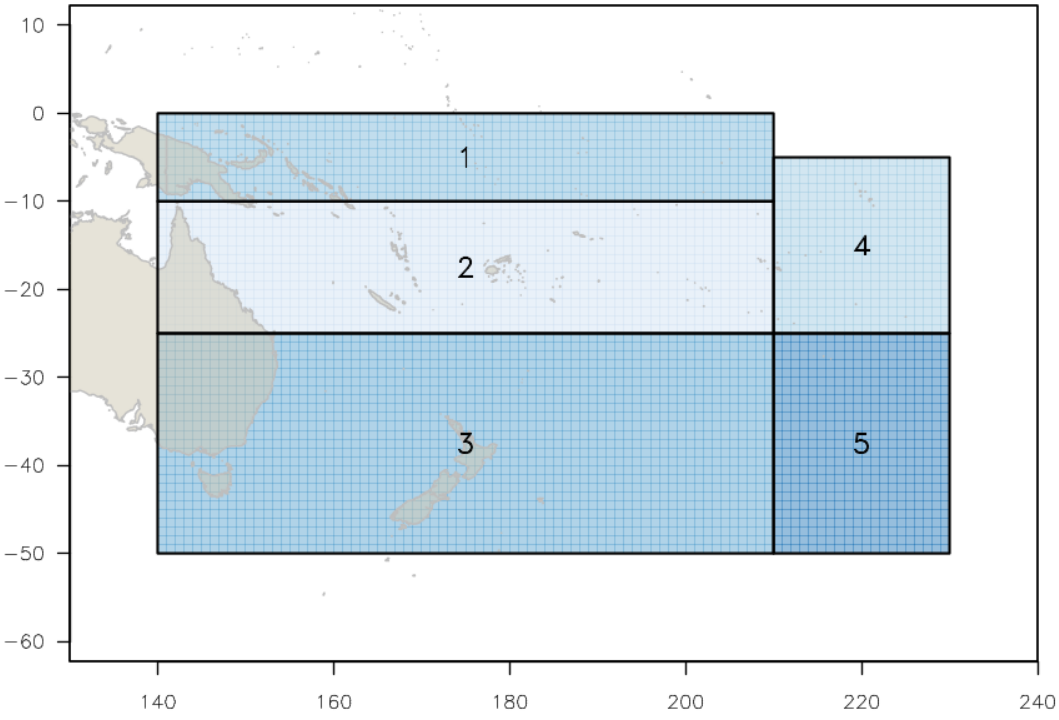
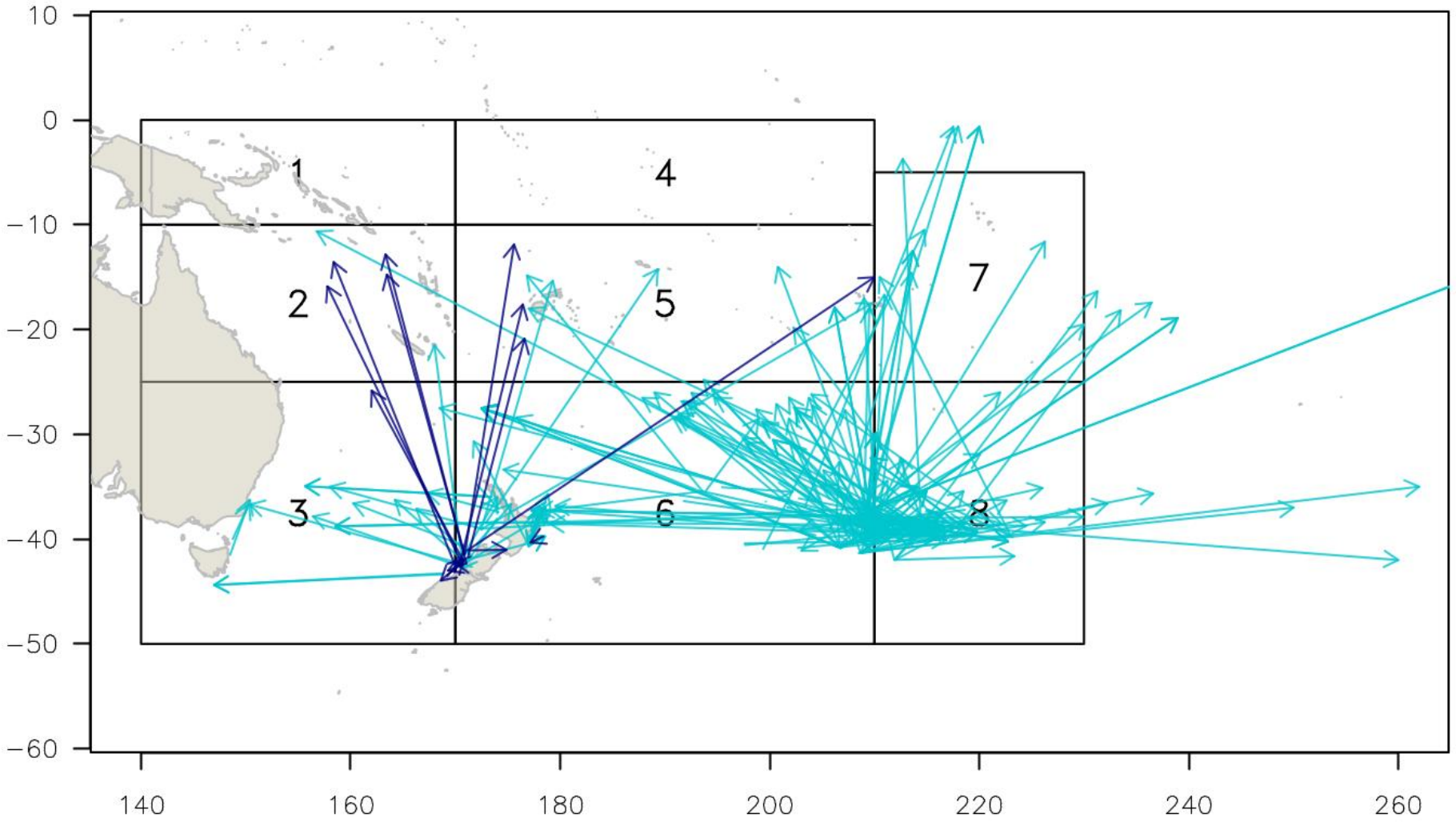
2015 Regions



2018 Regions



Prog		RTTP			SPATP	
Years		1986–1992			2009–2010	
Category	Grps	Rel	Rec	Grps	Rel	Rec
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	13	4154	95	2	1019	21
4	0	0	0	0	0	0
5	9	1706	30	0	0	0
Total	22	5861	125	2	1019	21



GEOSTATISTICAL VS. TRADITIONAL CPUE

	Geostatistical CPUE	vs.	Traditional CPUE
Cell effect	Geostatistical (or 'spatio-temporal') surface		5x5 cells independent
Vessels	Not included		Included as covariate
Targeting group	Included as covariate		Included as covariate
Span	All assessment region *high-mixing*		Region-specific *low-mixing*

INDEX FISHERIES

- Best use of the fully integrated, multi-fleet standardised CPUE analyses
  - Expands spatial and temporal coverage for the indices of relative abundance
  - Avoids assigning the multi-fleet standardised CPUE time series to only one fleet (dynamic and patchy effort of longline fleets in the South Pacific)
- Capture vs. Index fisheries:

  -- Size data weighted by CPUE for the Index fisheries (representing the albacore population)

  -- Size data weighted by CATCH for the Capture fisheries (representing the albacore catch)

  Downweighted catch data to account for index fisheries

MATURITY AT AGE

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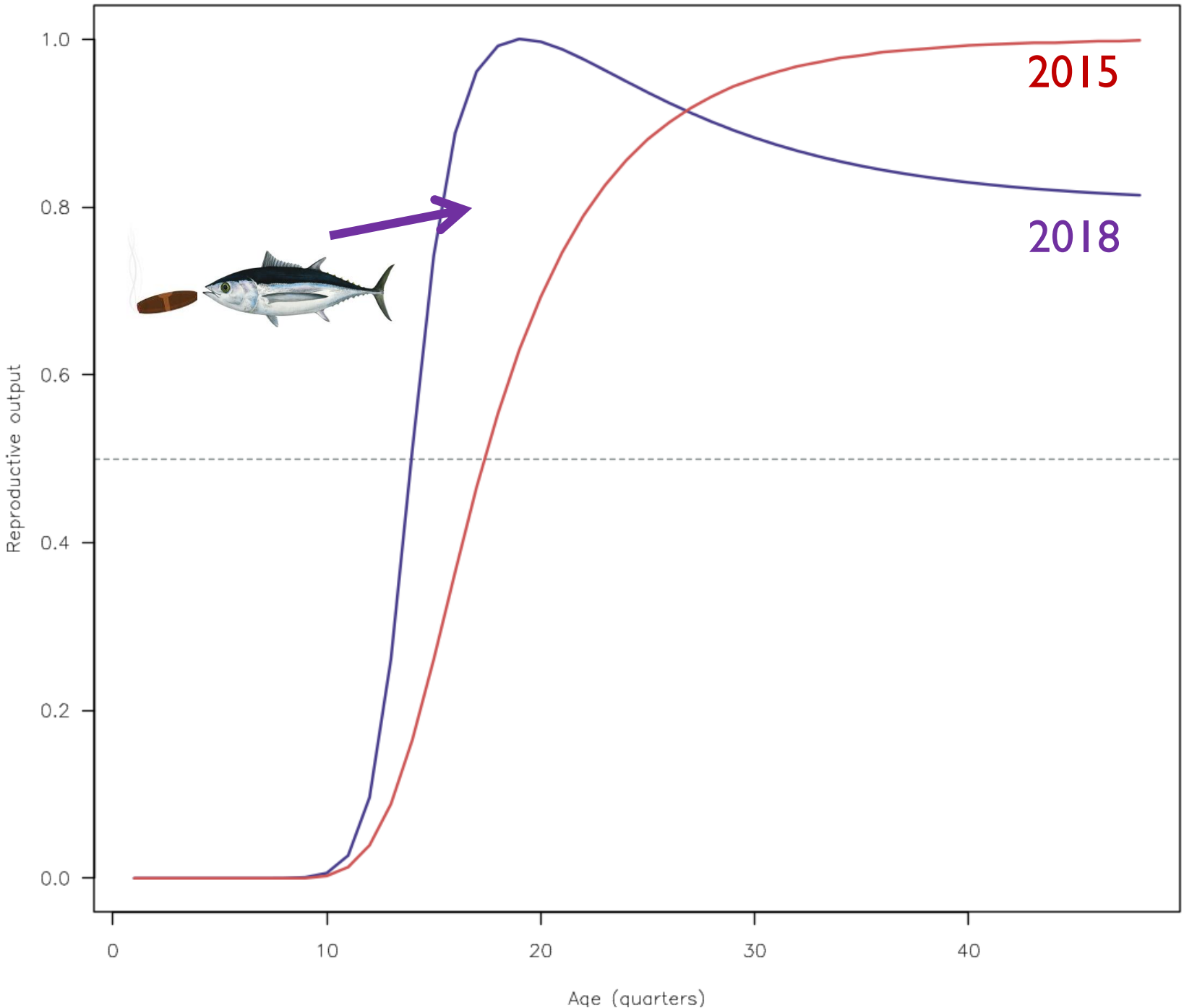
Maturity-at-length



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SPATIAL DISTRIBUTION OF CATCH

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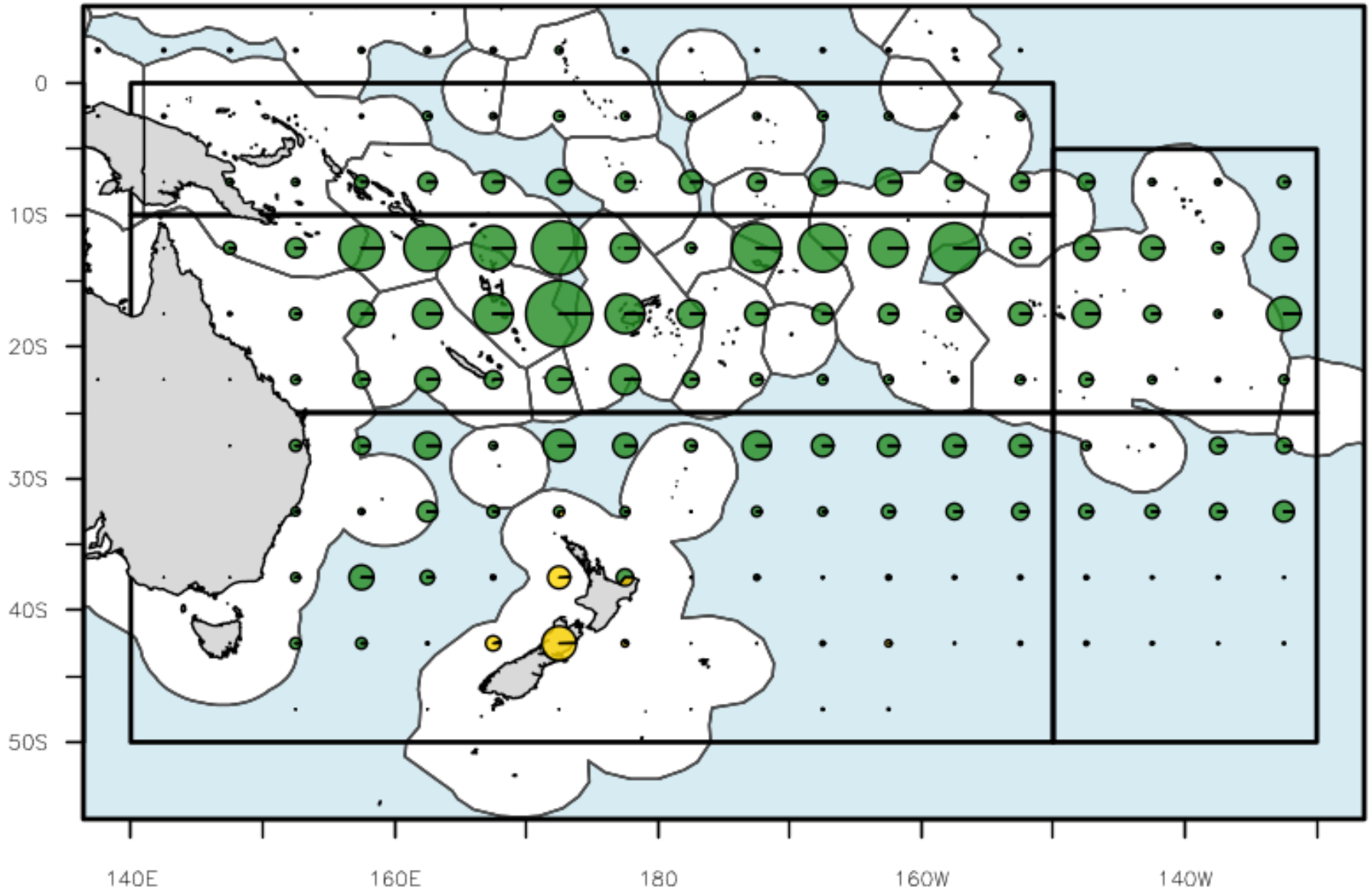
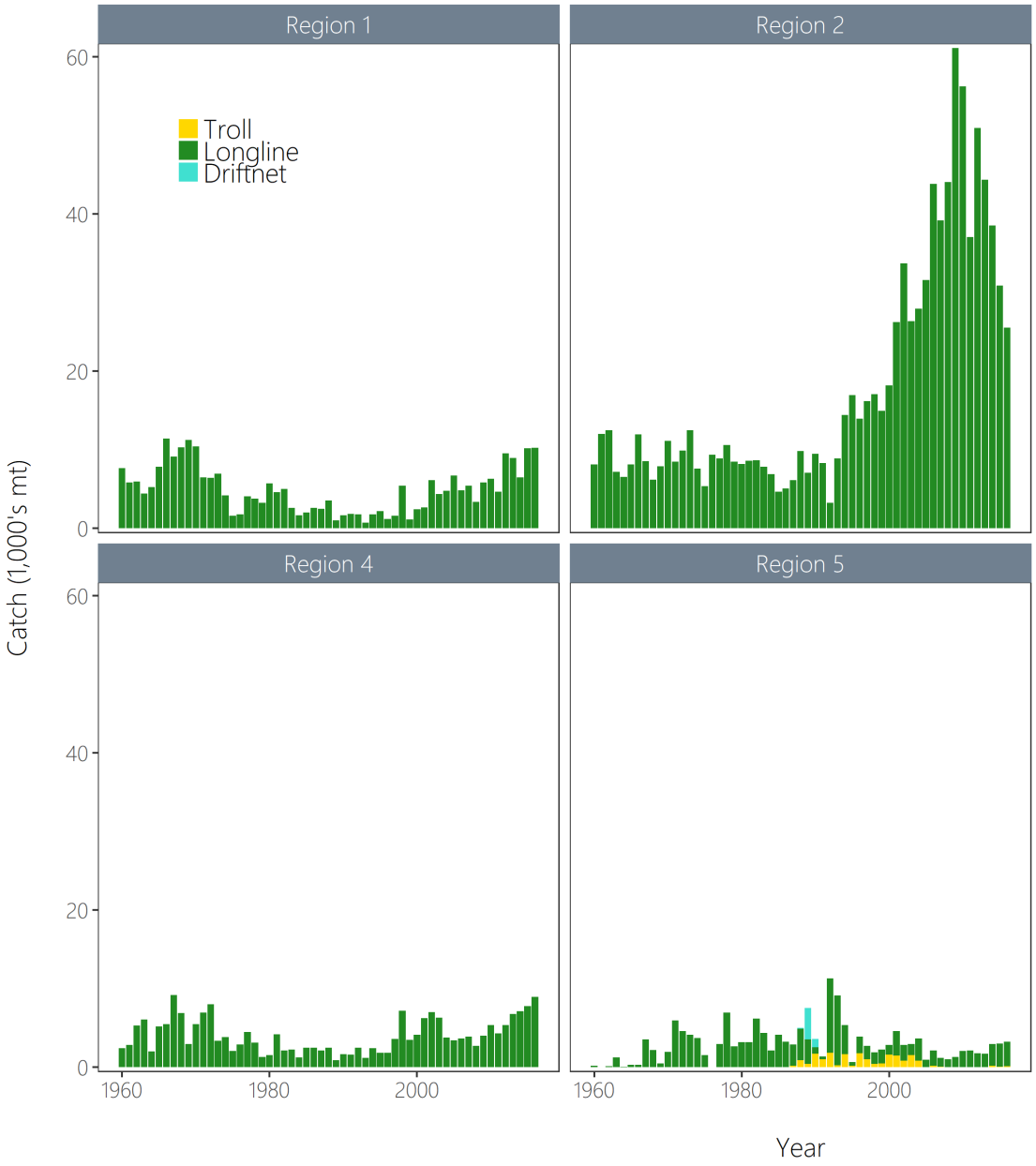
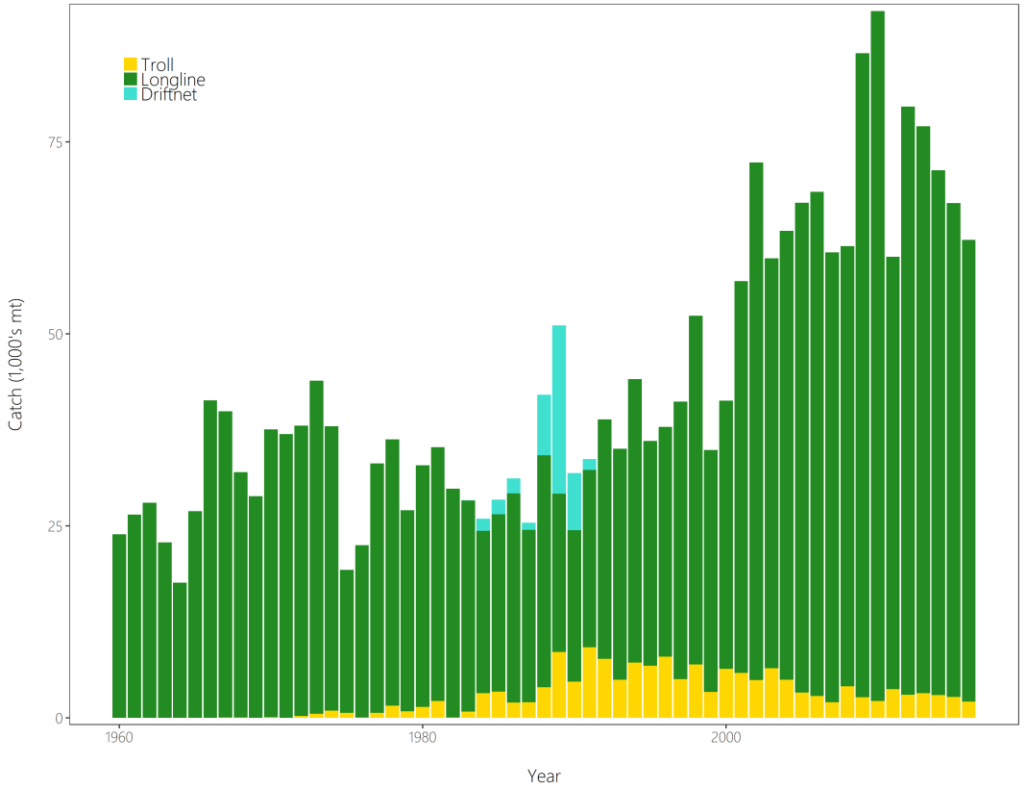






CATCH HISTORIES

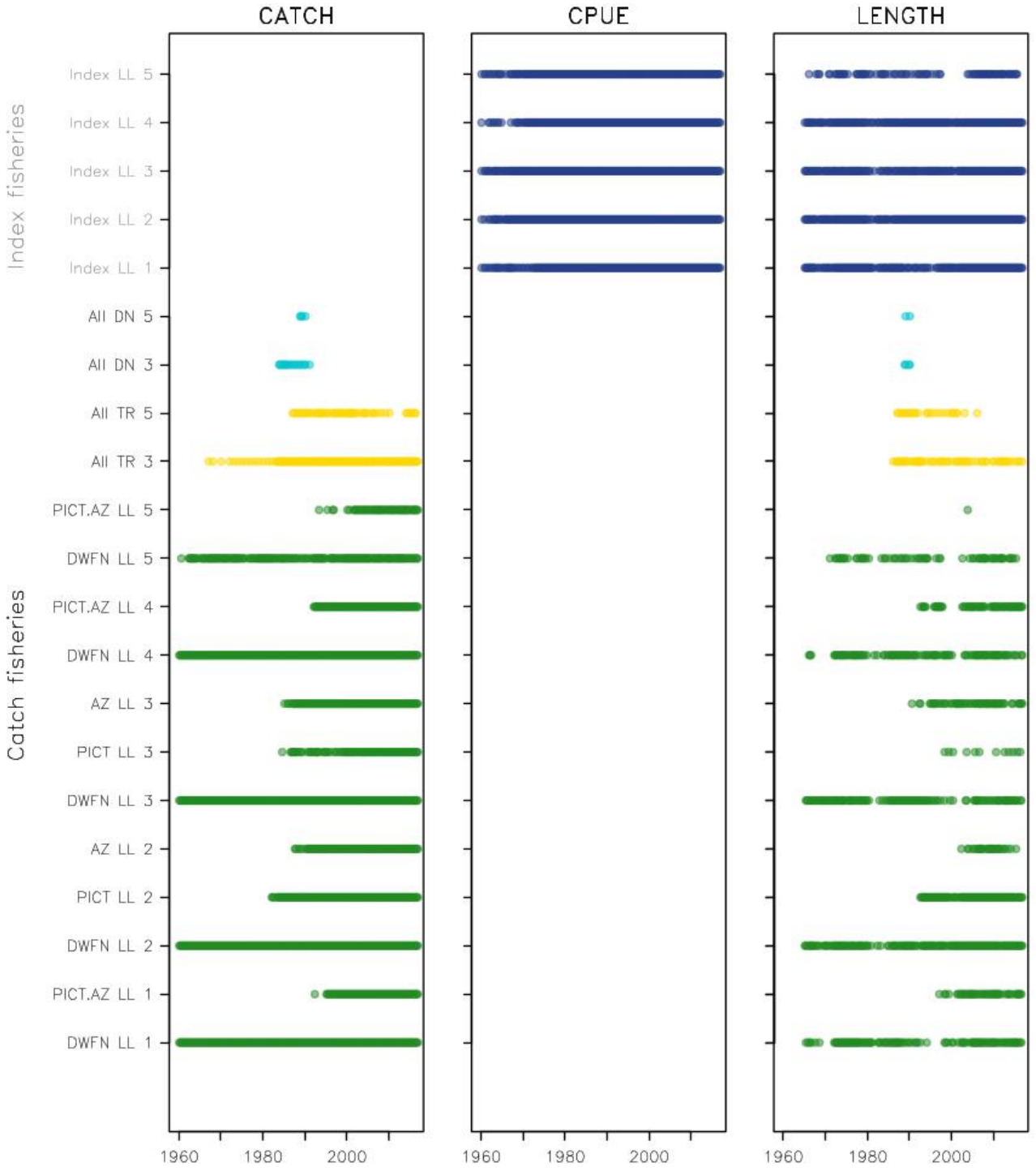
FISHERIES DEFINITIONS

- 16 + 5 fisheries
- 1960-2016
- Quarterly time-steps
- 1 standardised CPUE in each region (5 Index LL fisheries)
- Length data only
- Few tags

Longline split into:
DWFNs, PICTs, AU/NZ

Troll:
All fleets

Driftnet:
All fleets



CPUE INDICES – TRADITIONAL VS GEOSTATS

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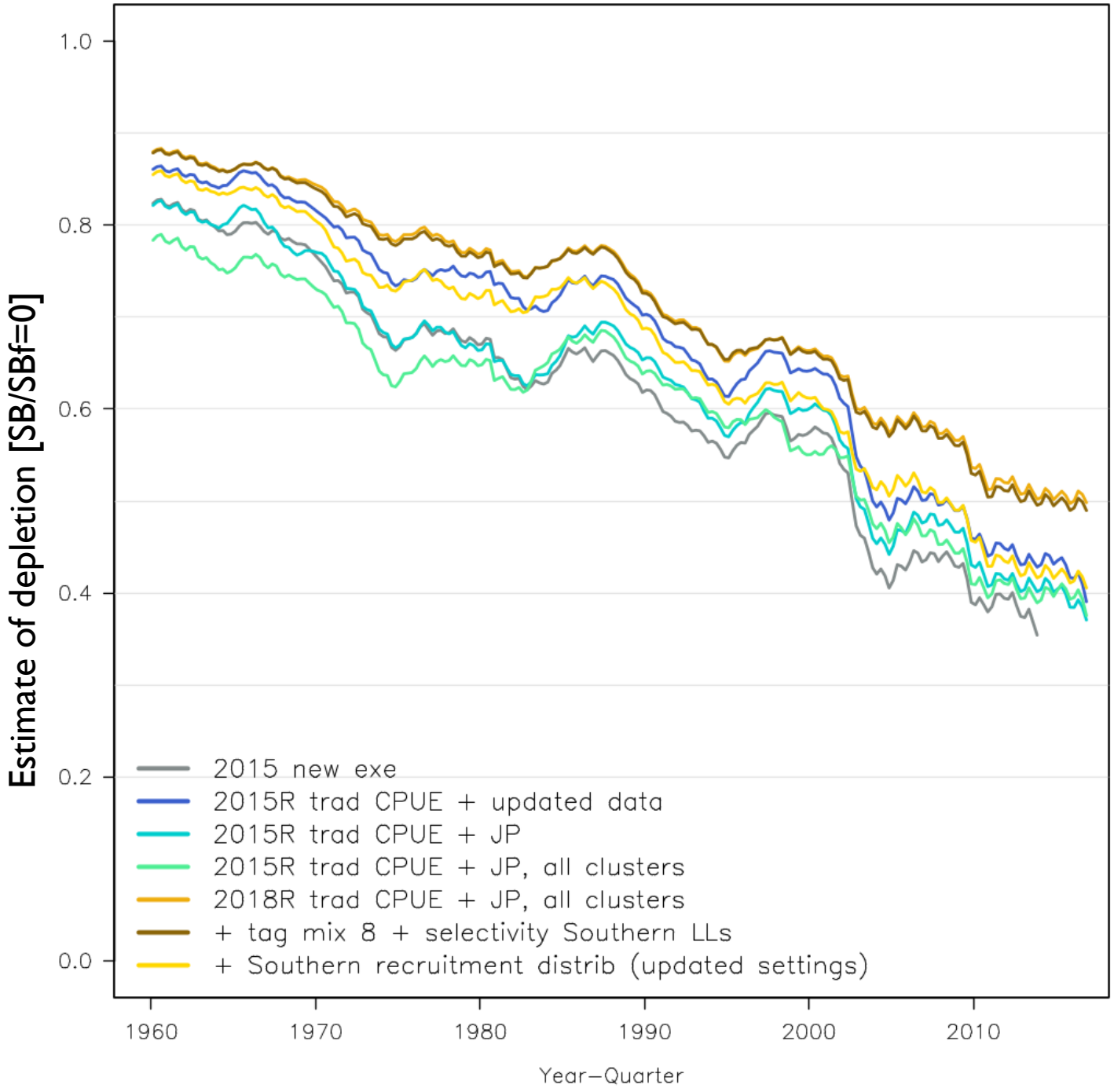

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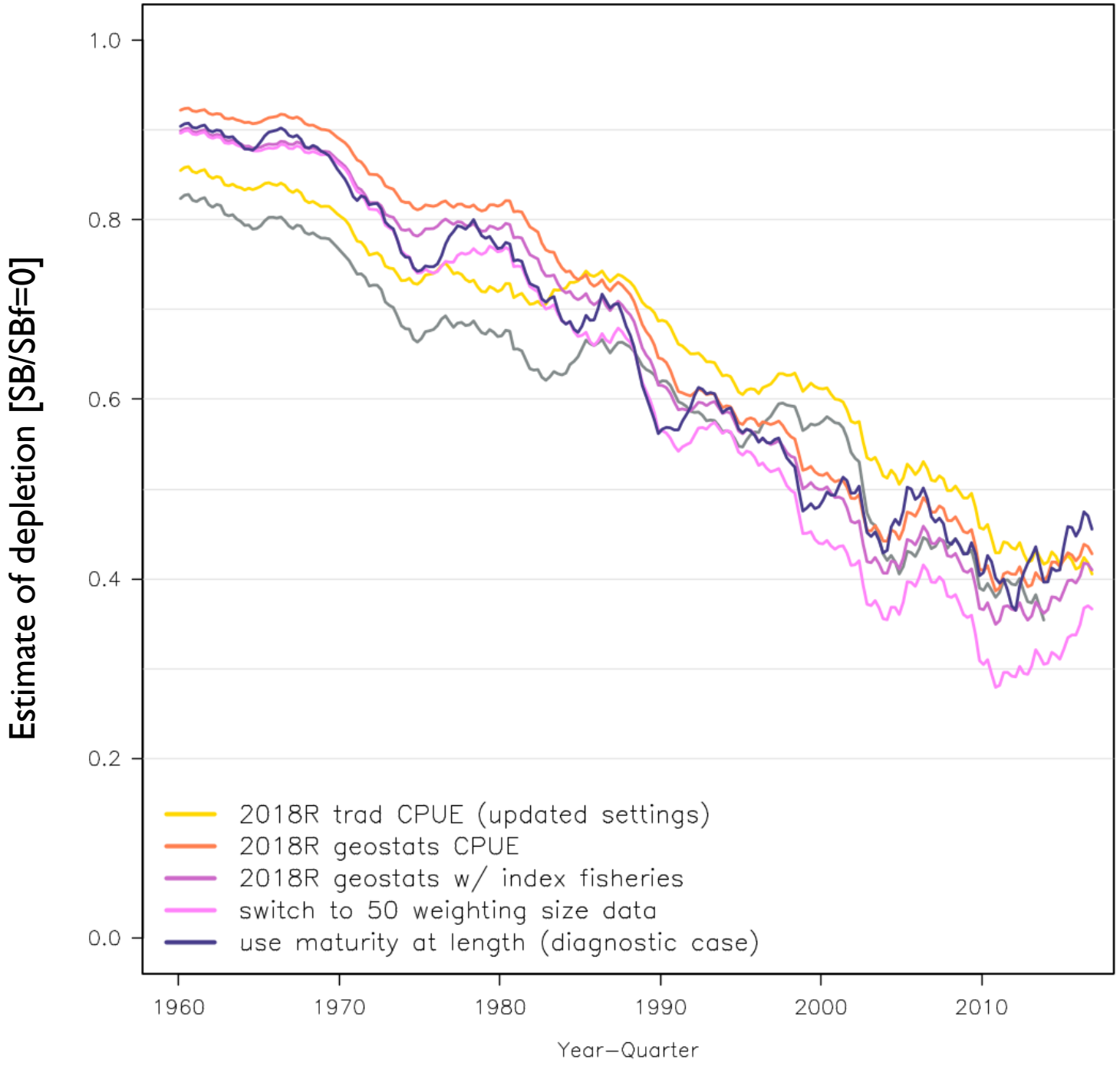

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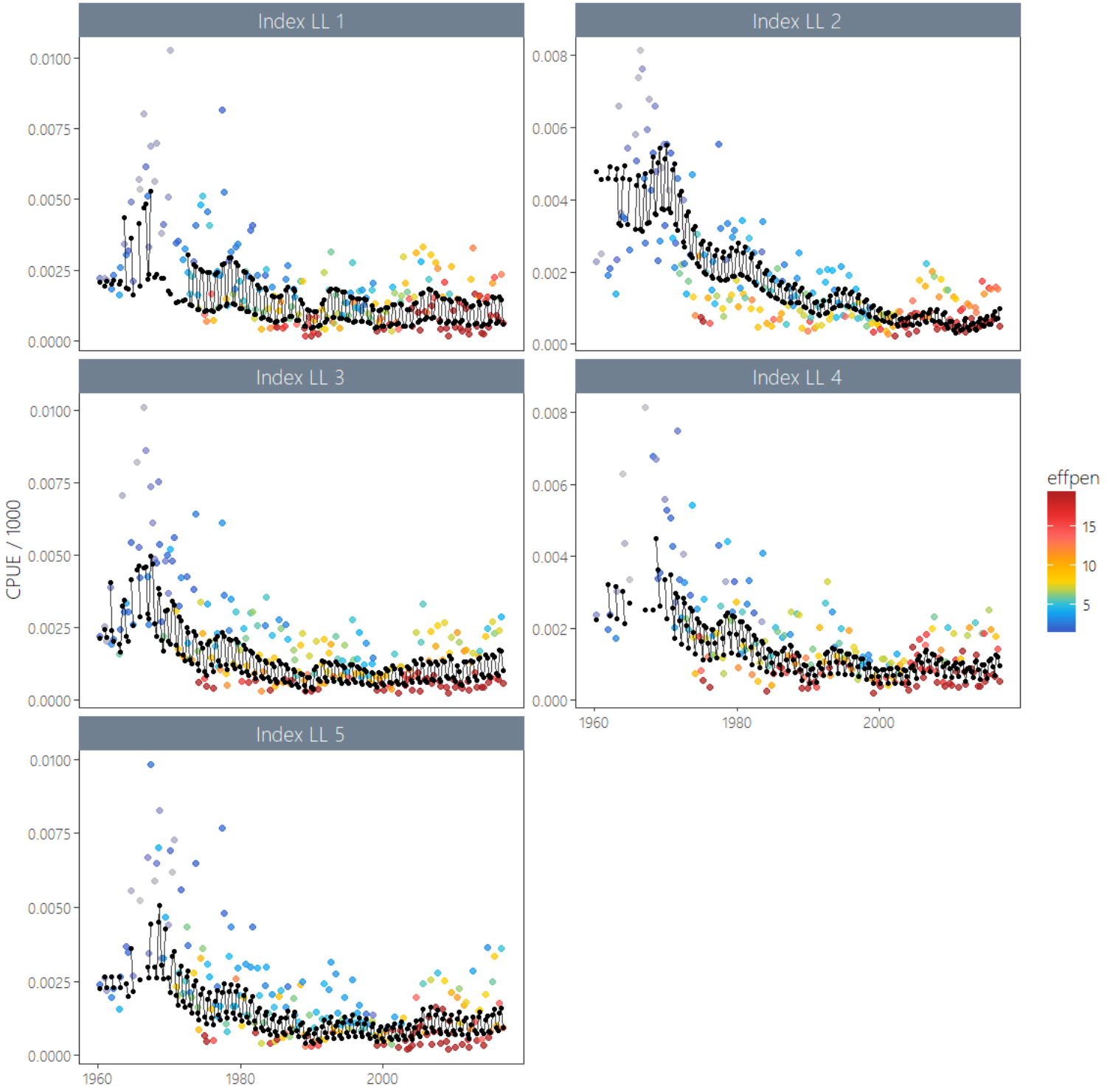
FIT TO CPUE DATA



FIT TO LENGTH FREQUENCY DATA

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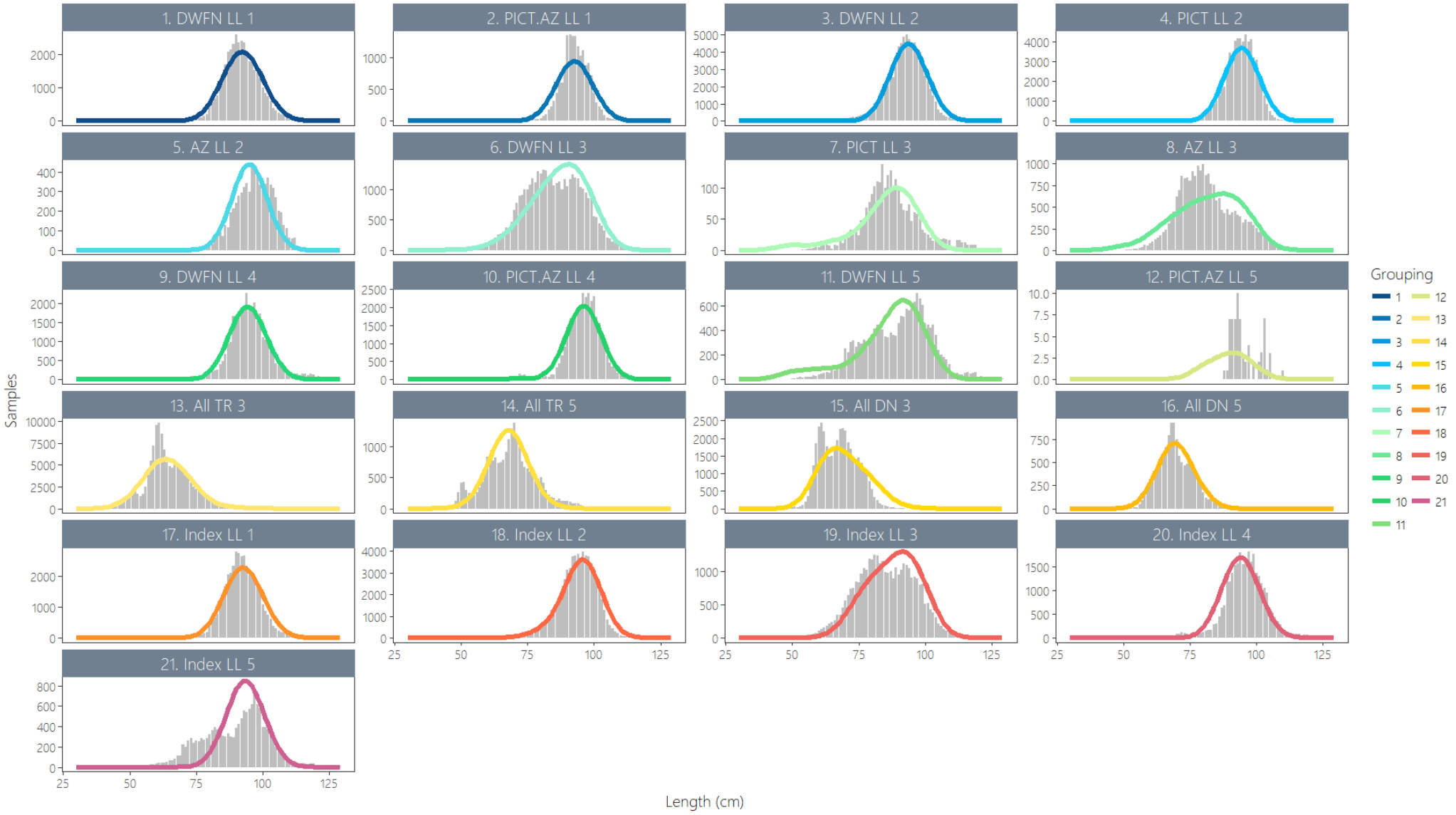

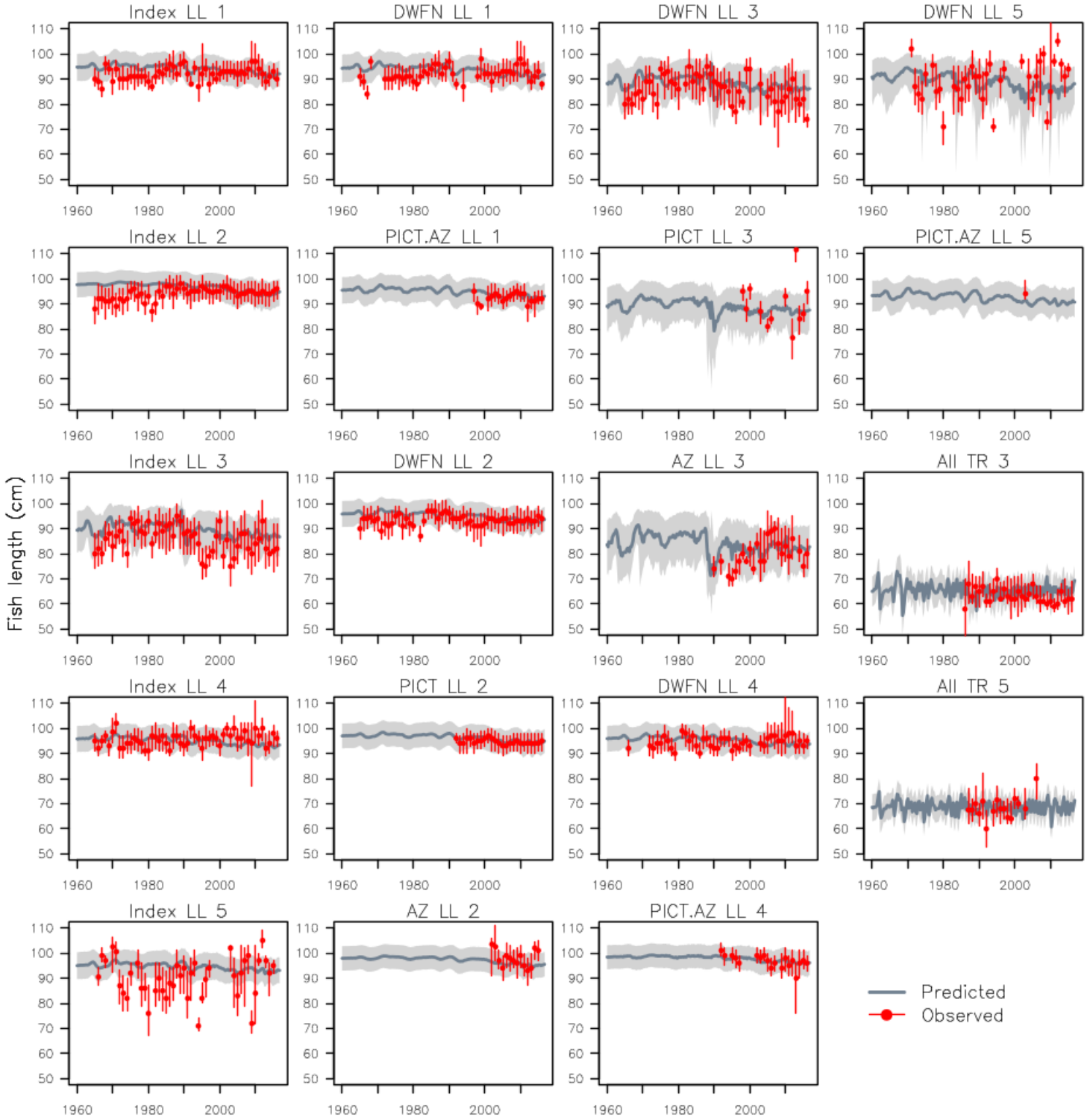

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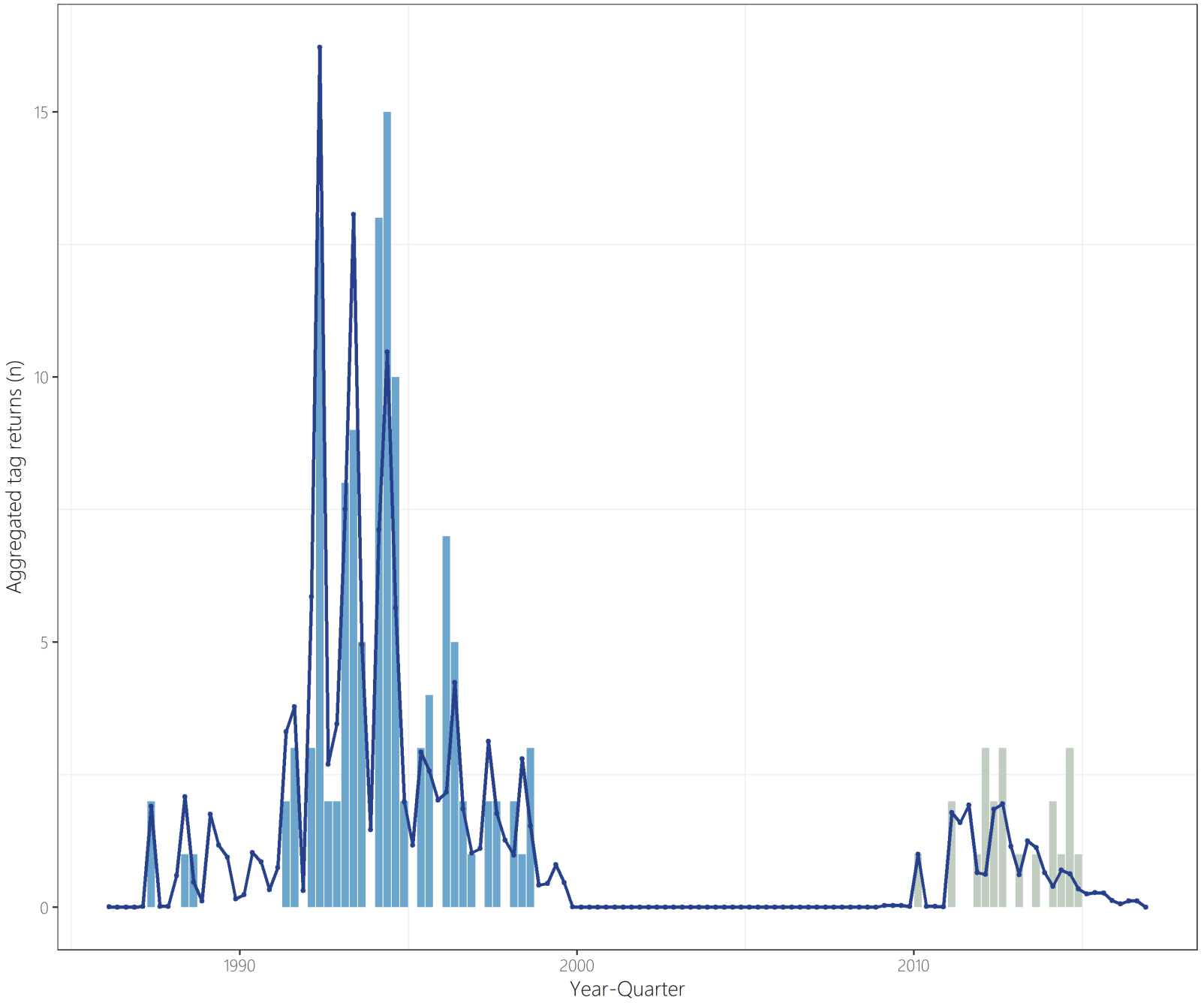
FIT TO TAGGING DATA



GROWTH CURVES AND DATA

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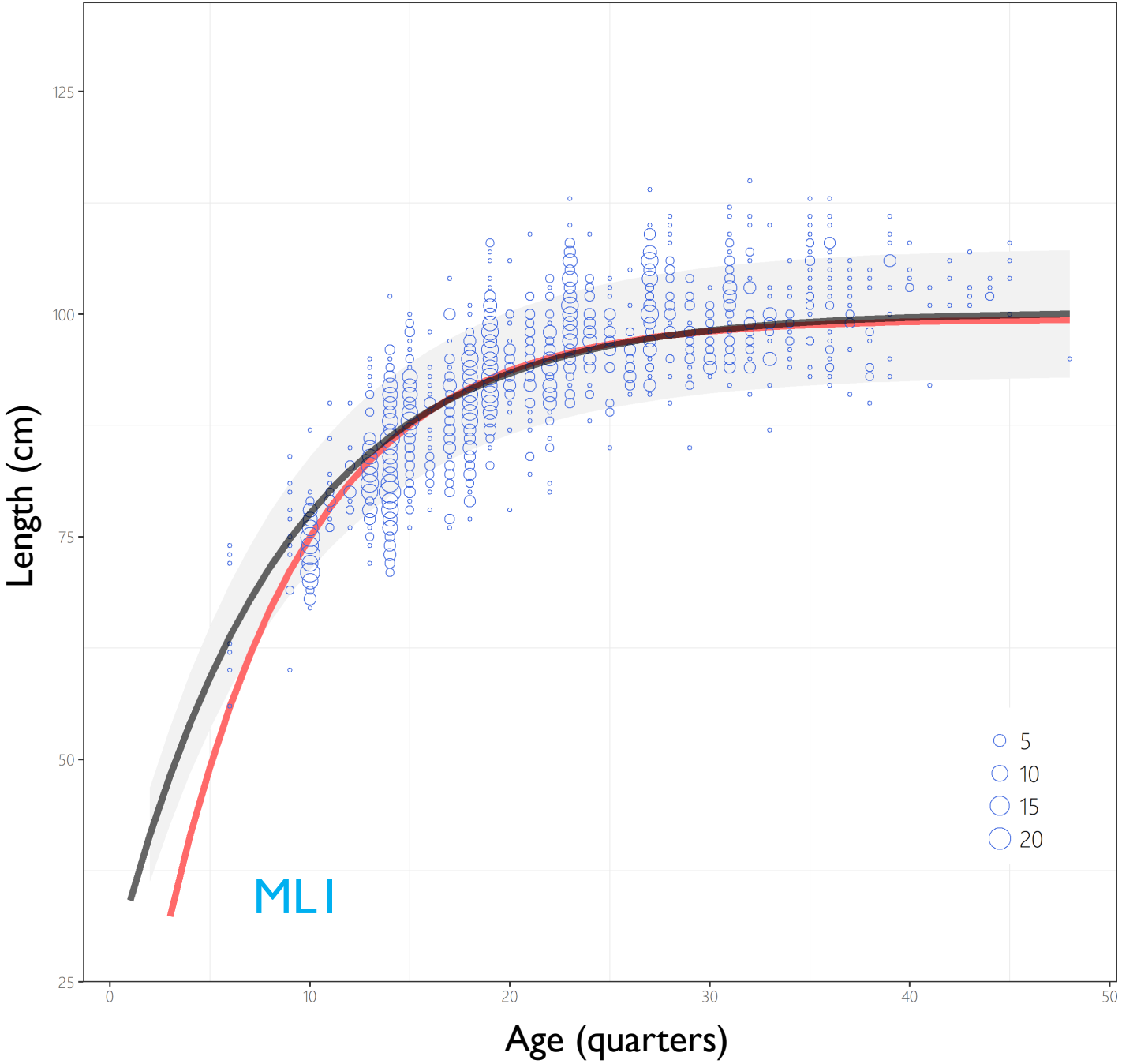
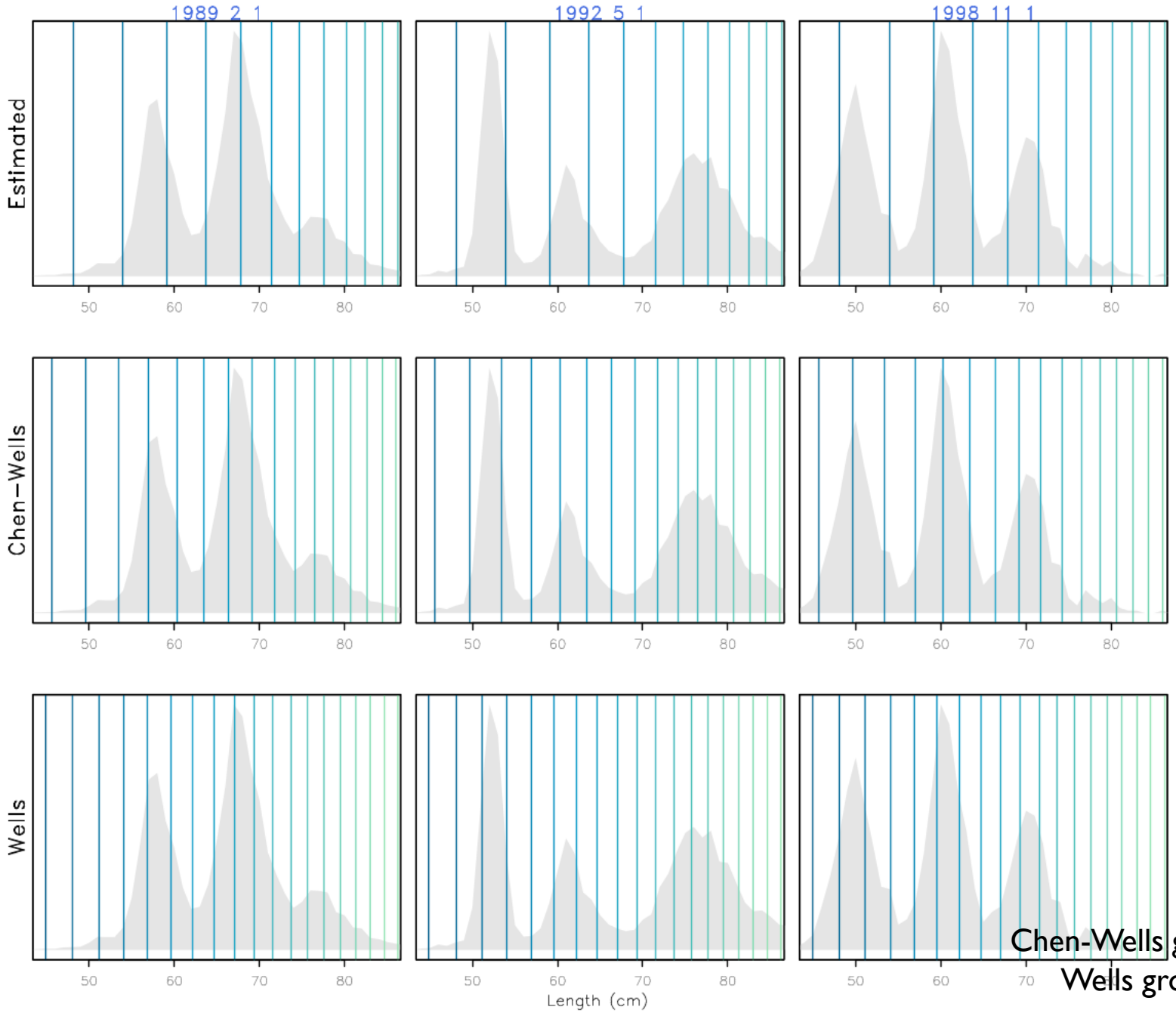


Black = estimated
Red = 2015 growth

GROWTH: MIXED SIGNALS

Fit to annual troll modes?



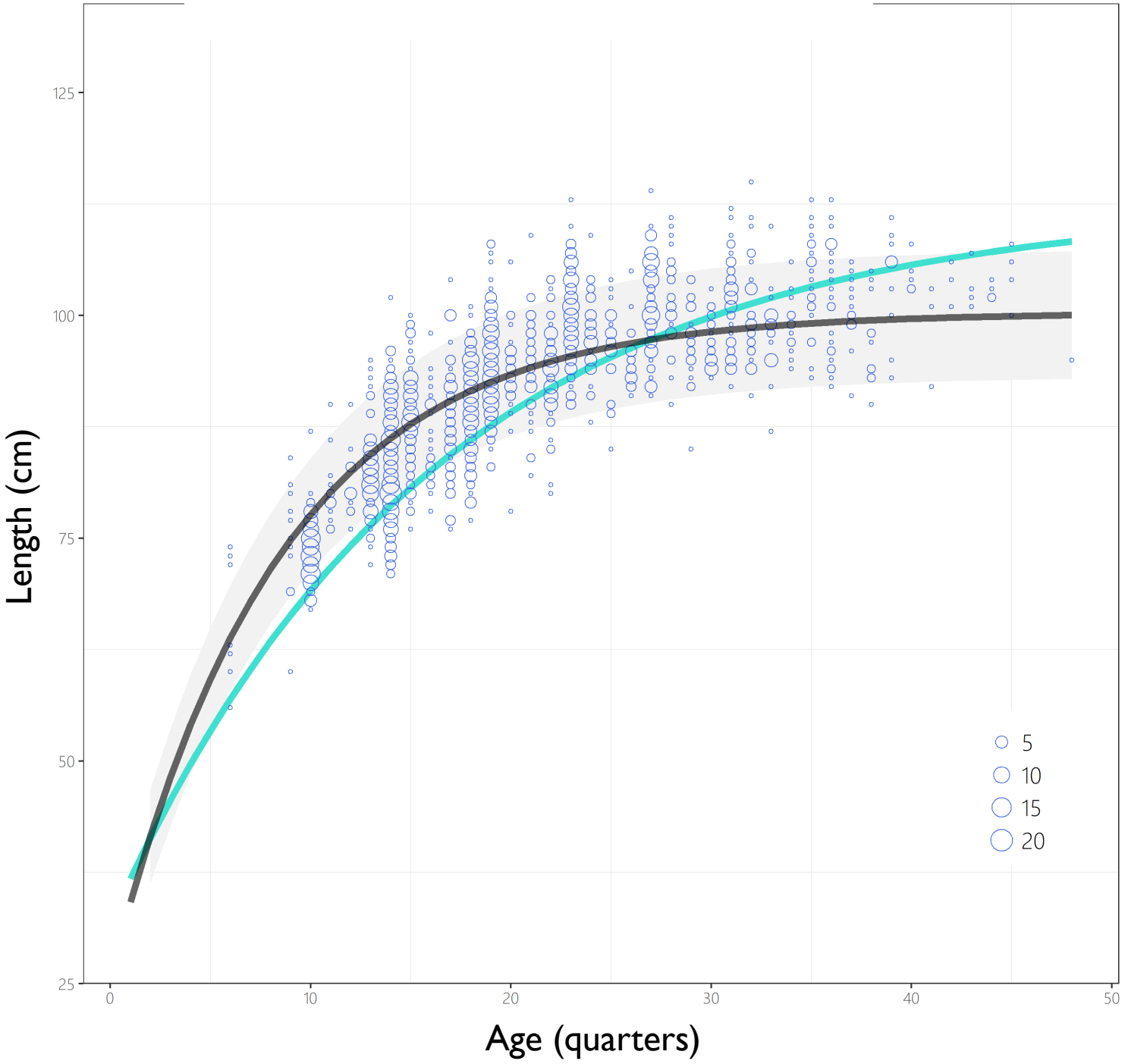
Nope.

Better…

Yes! but…

Chen-Wells growth *cf.* Xu et al. (2014)
Wells growth *cf.* Wells et al. (2013)

GROWTH CURVES AND DATA



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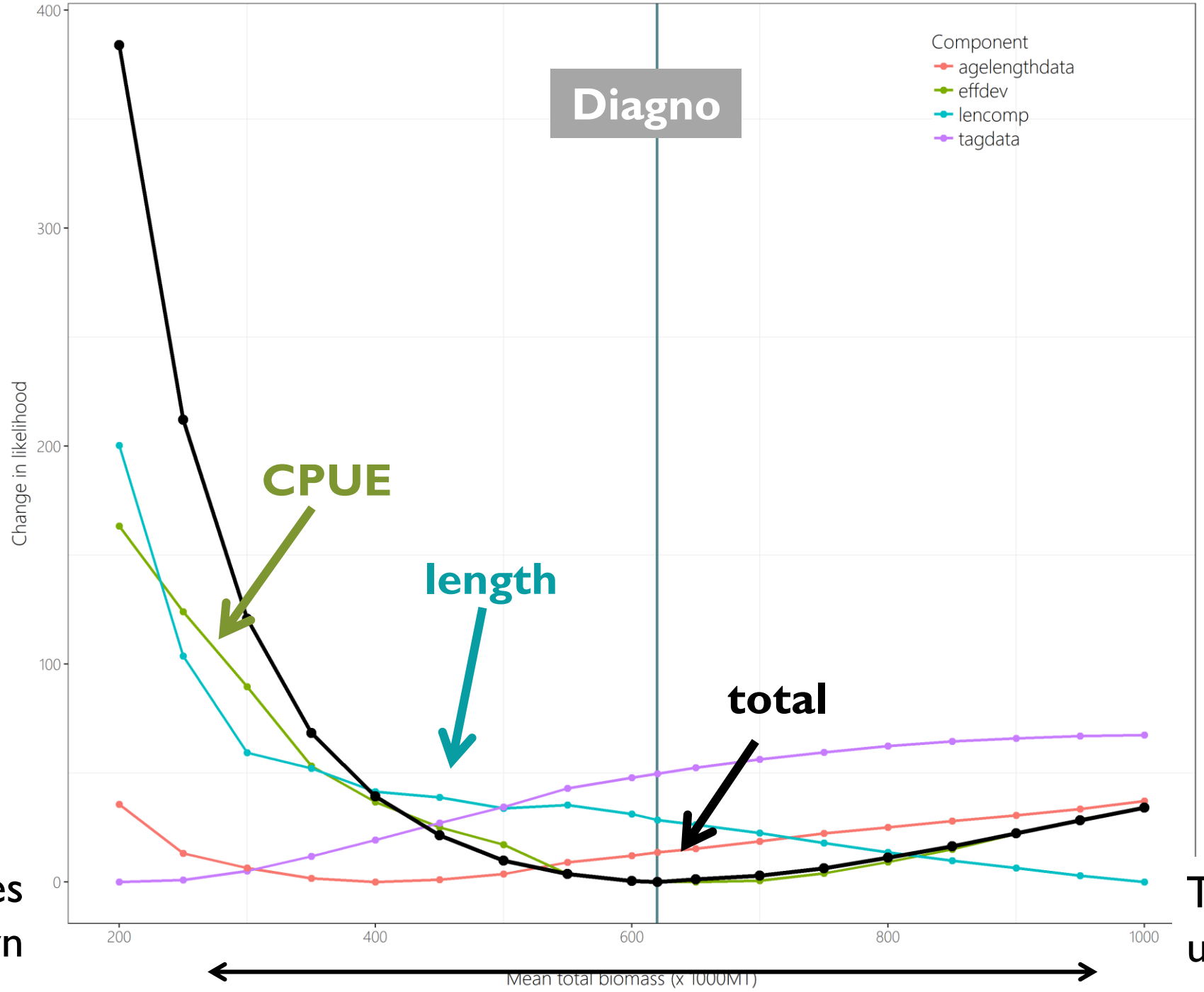
Green = Chen-Wells

Chen-Wells growth *cf.* Xu et al. (2014)

LIKELIHOOD PROFILE



TB scales down

TB scales up

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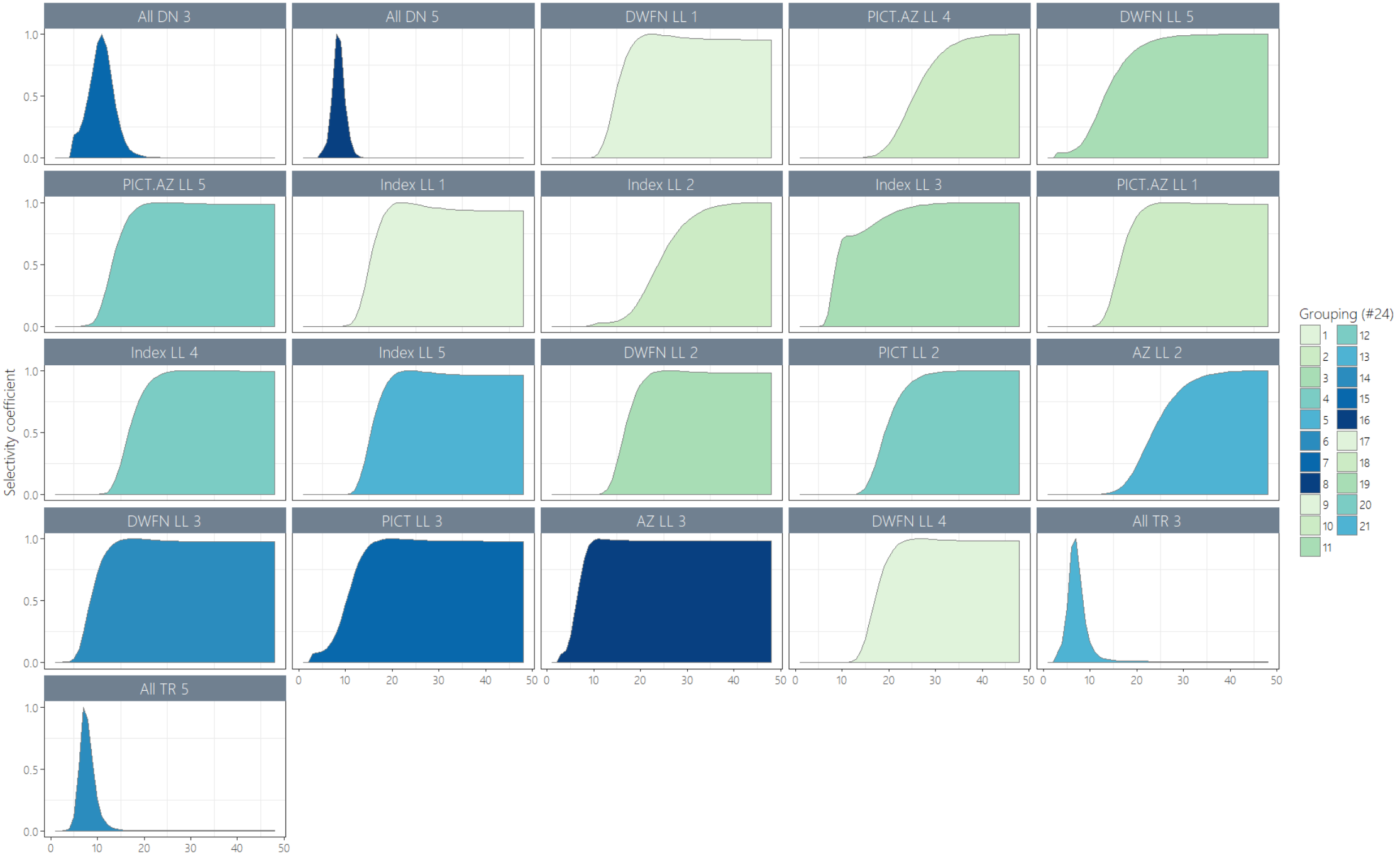
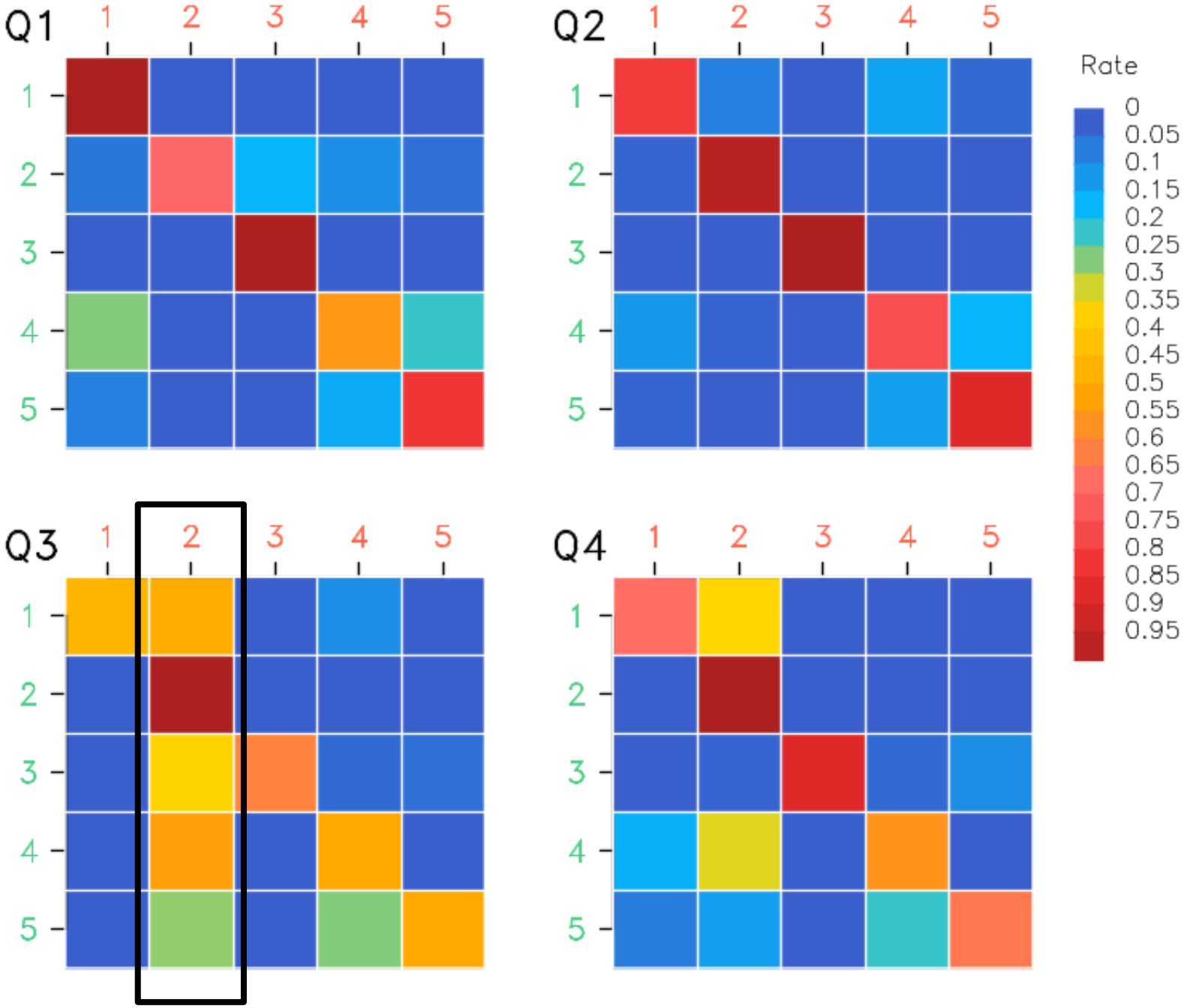
SELECTIVITY

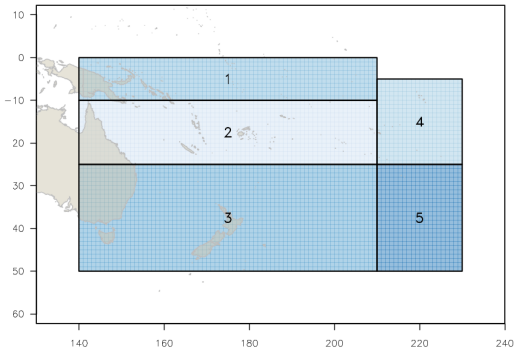


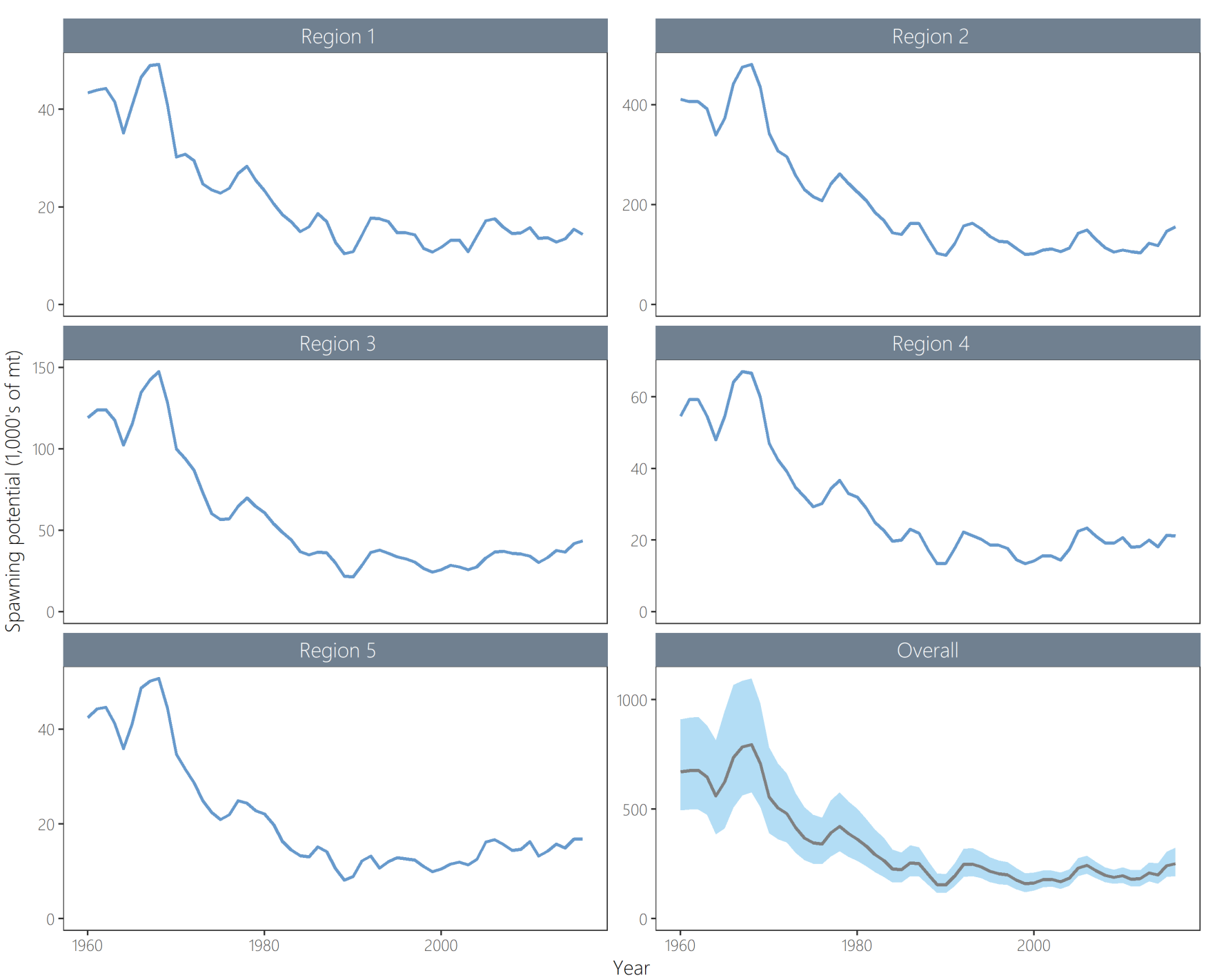
MOVEMENT

TO

FROM







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STOCK-RECRUITMENT RELATIONSHIP

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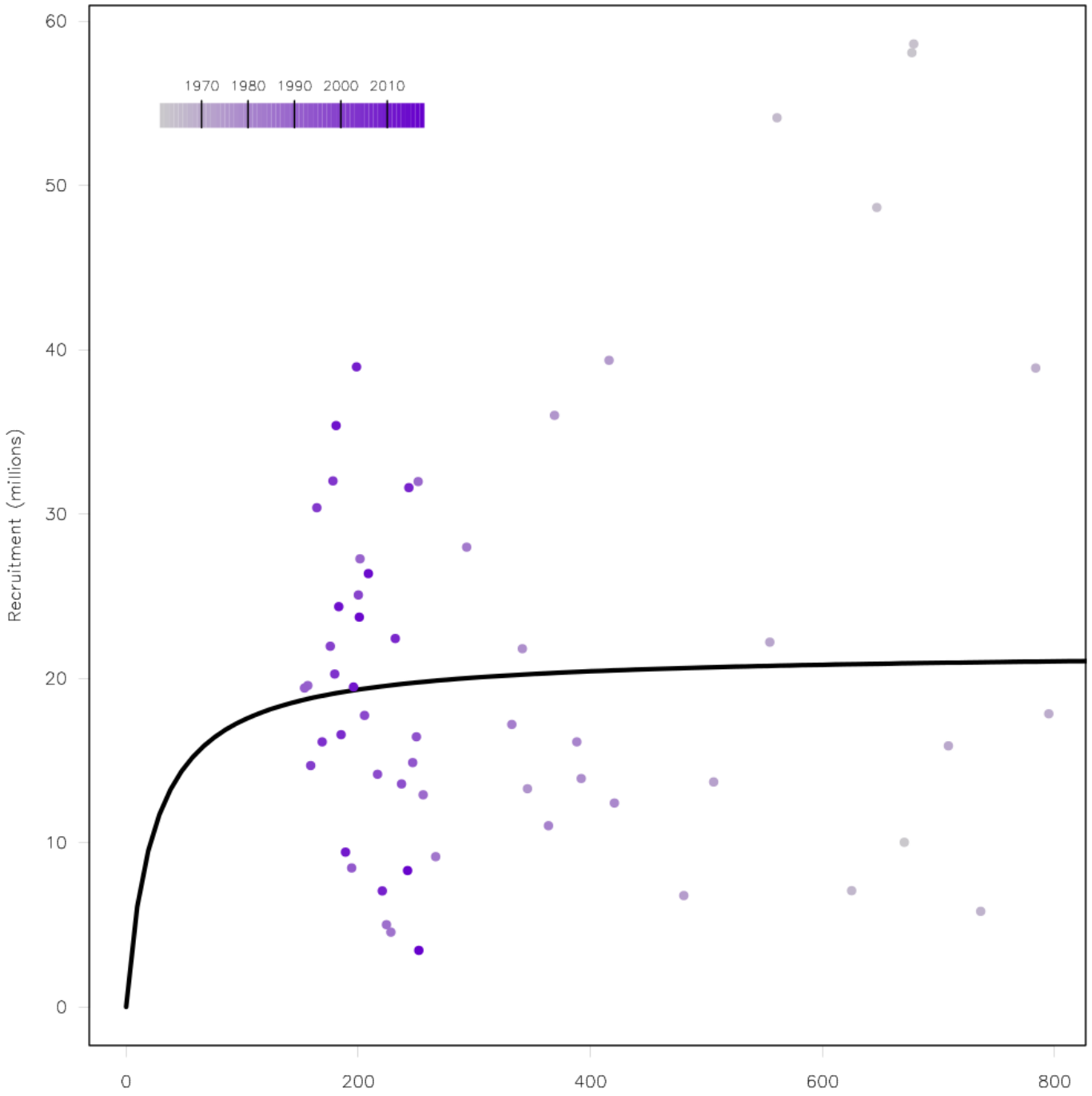

RECRUITMENT DYNAMICS

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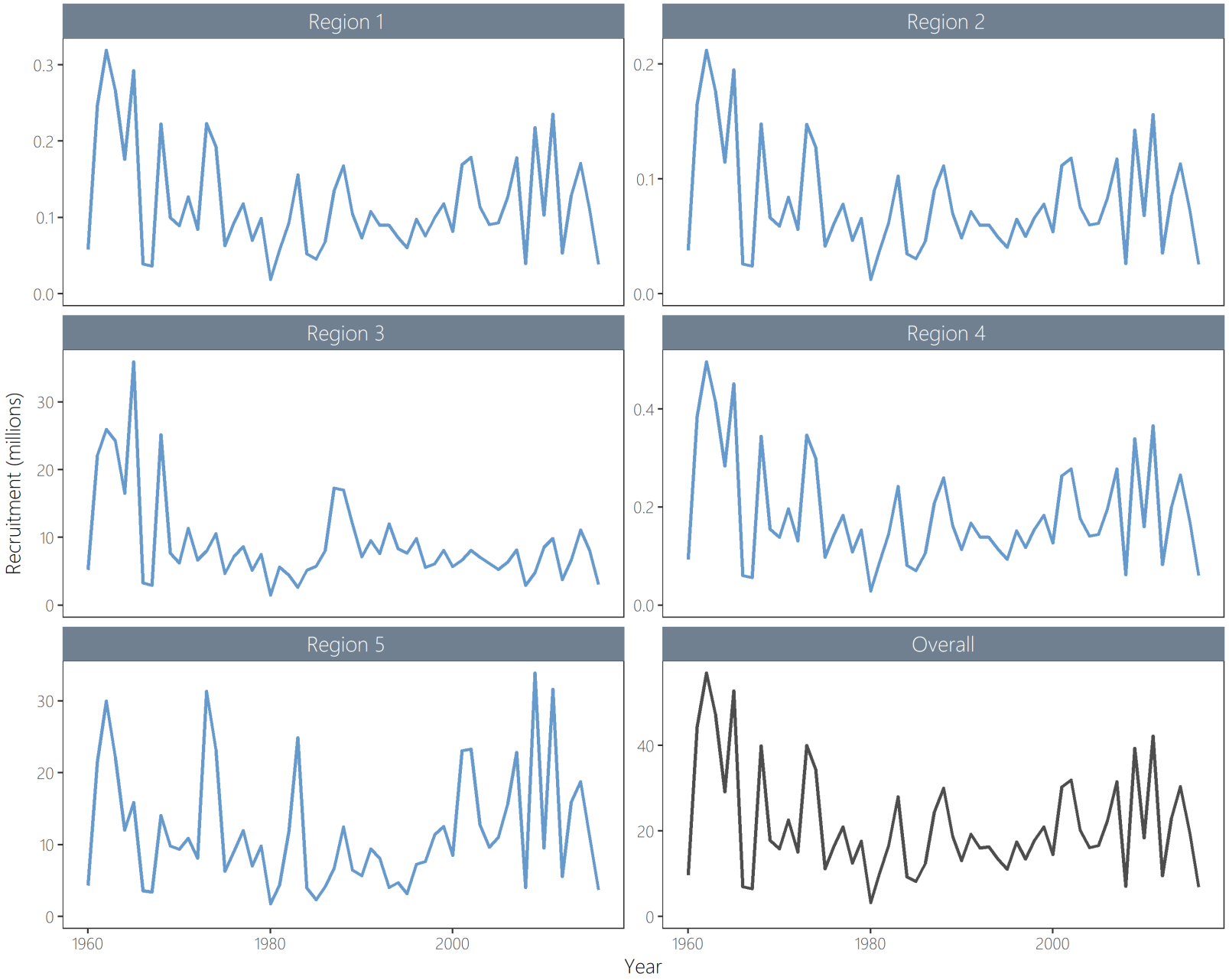

Key model predictions:
Spawning potential and recruitment

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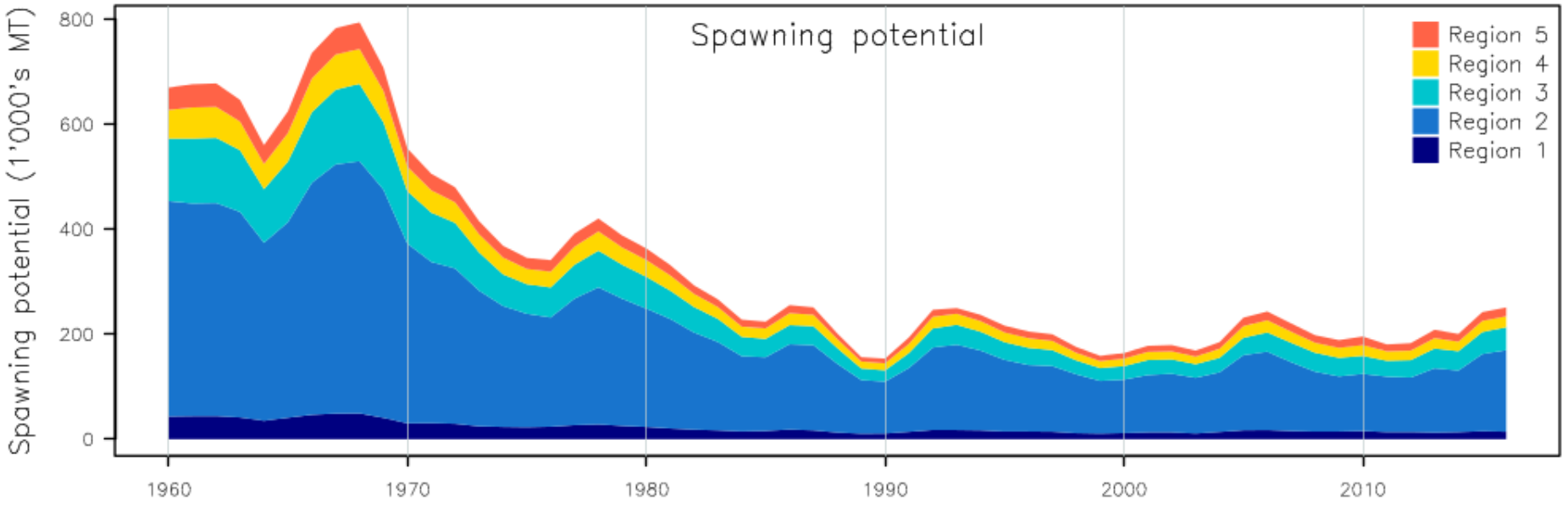

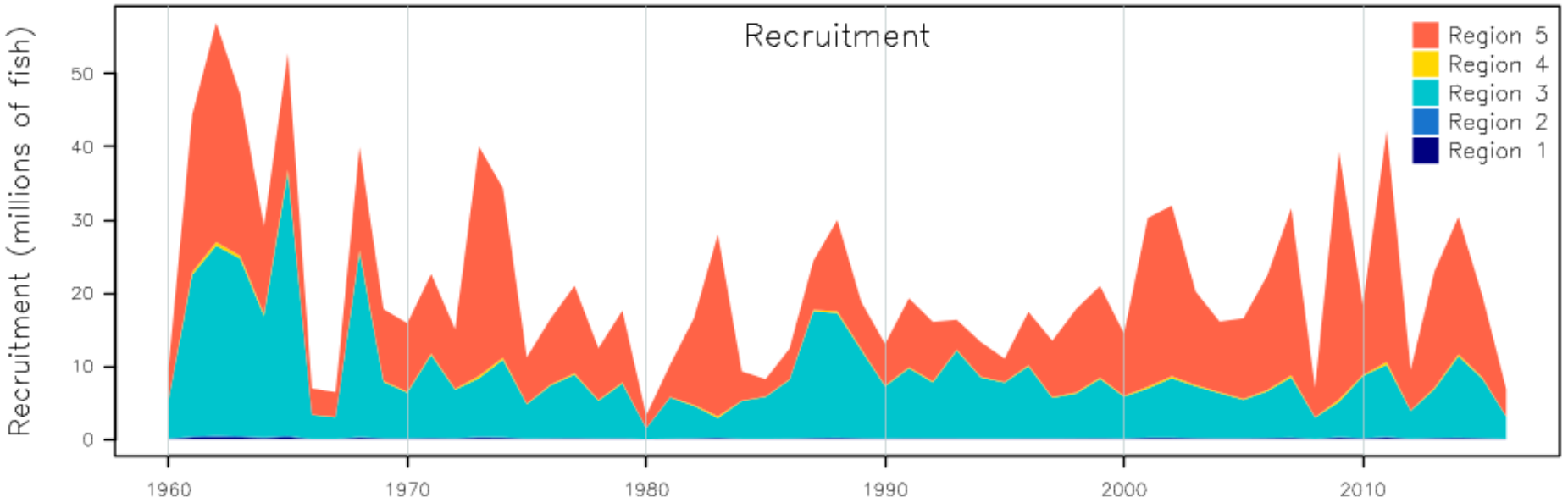

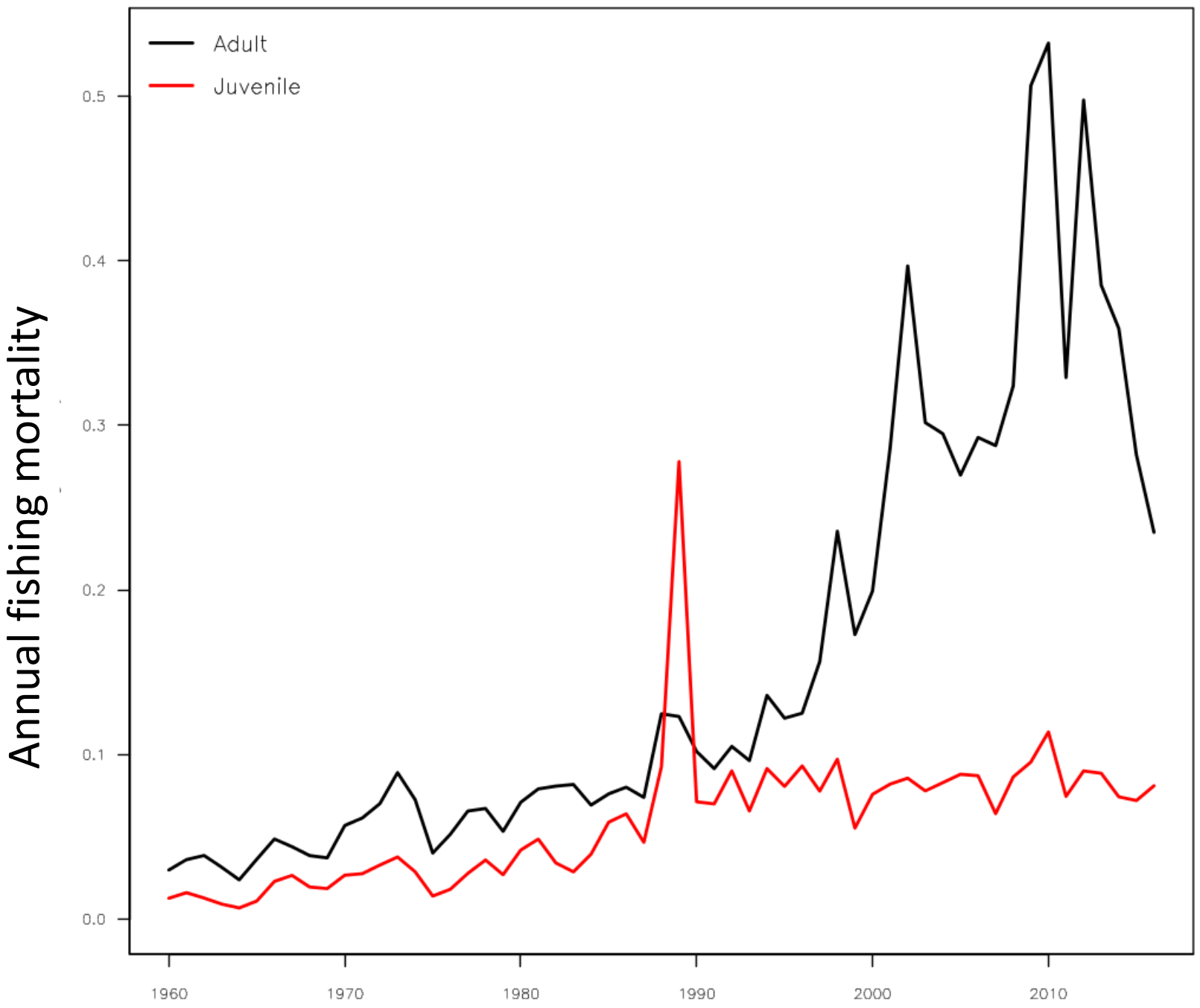

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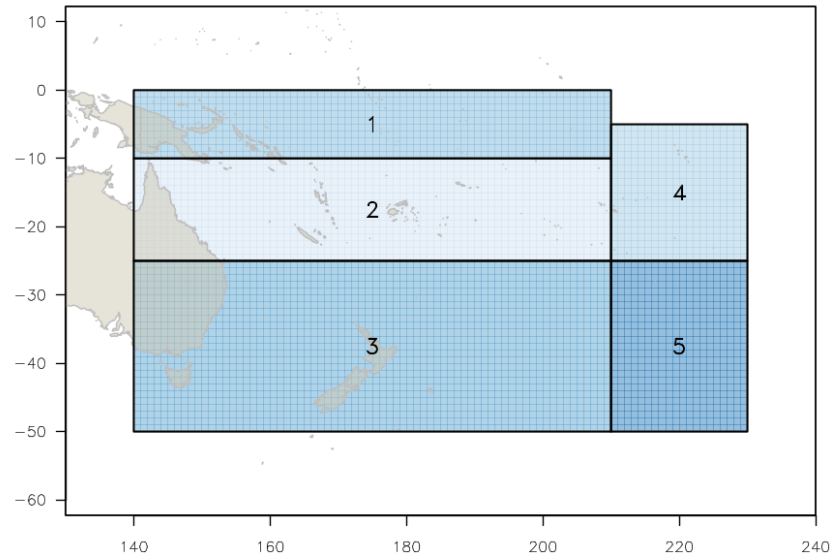
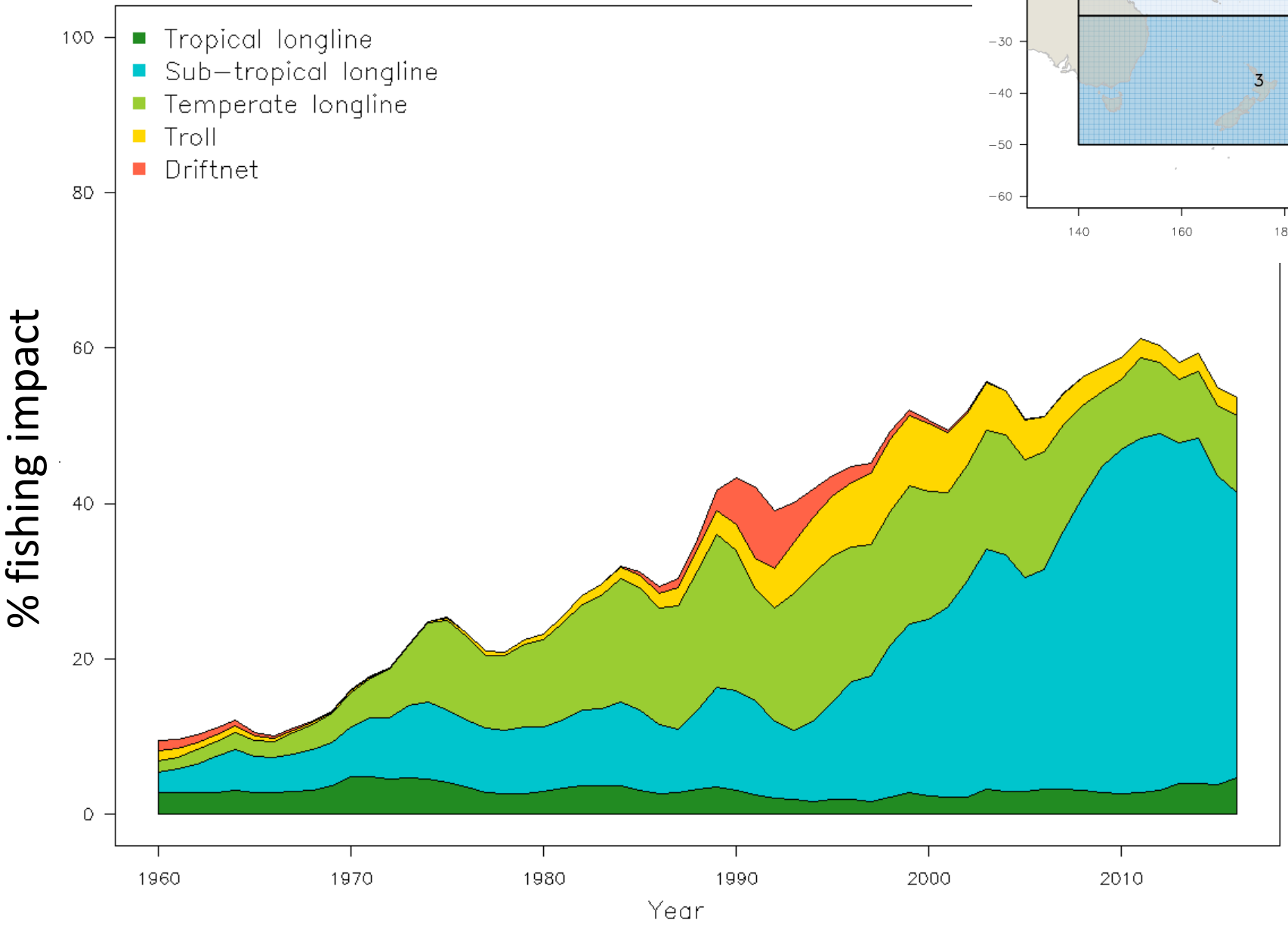
FISHING IMPACT

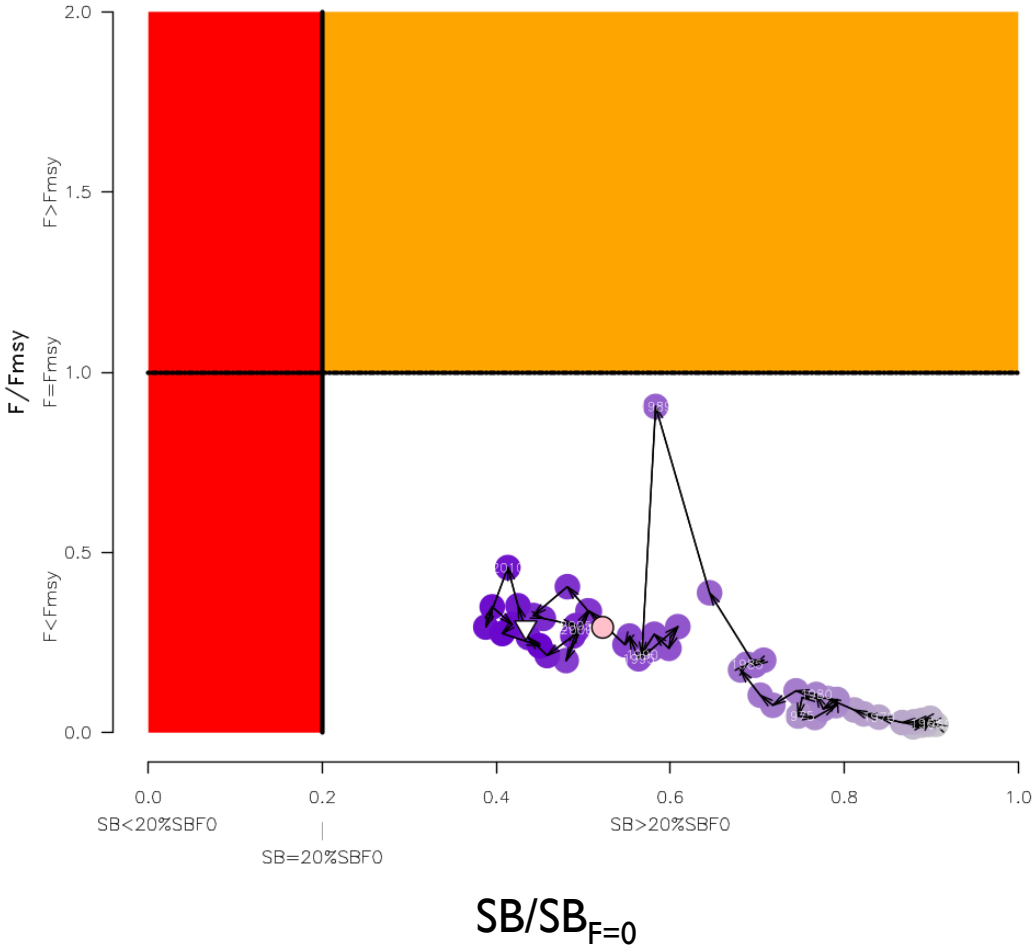


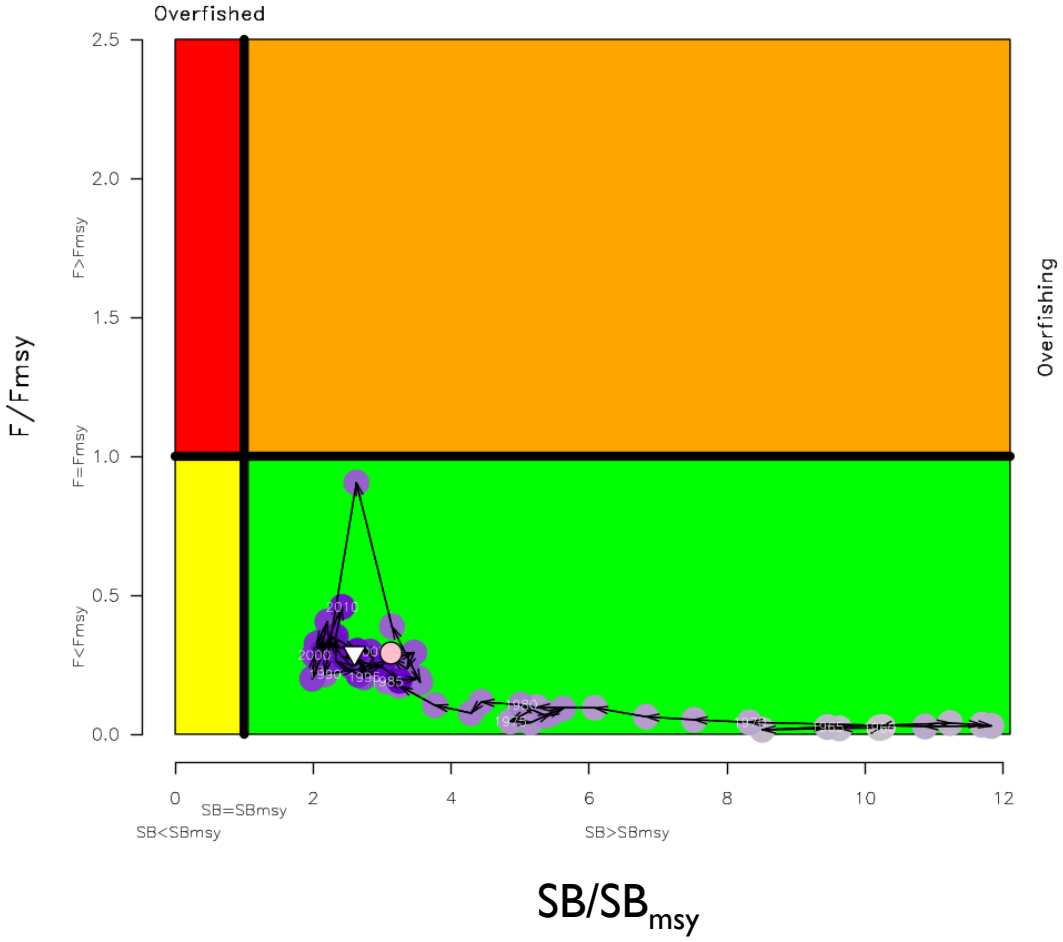


MSY VS. CATCH


Catch by gear / MSY (1000mt)
0
20
40
60
80
1960
1970
1980
1990
2000
2010
Driftnet
Troll
Longline

MAJURO/KOBE FOR DIAGNOSTIC CASE





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ONE-OFF SENSITIVITIES

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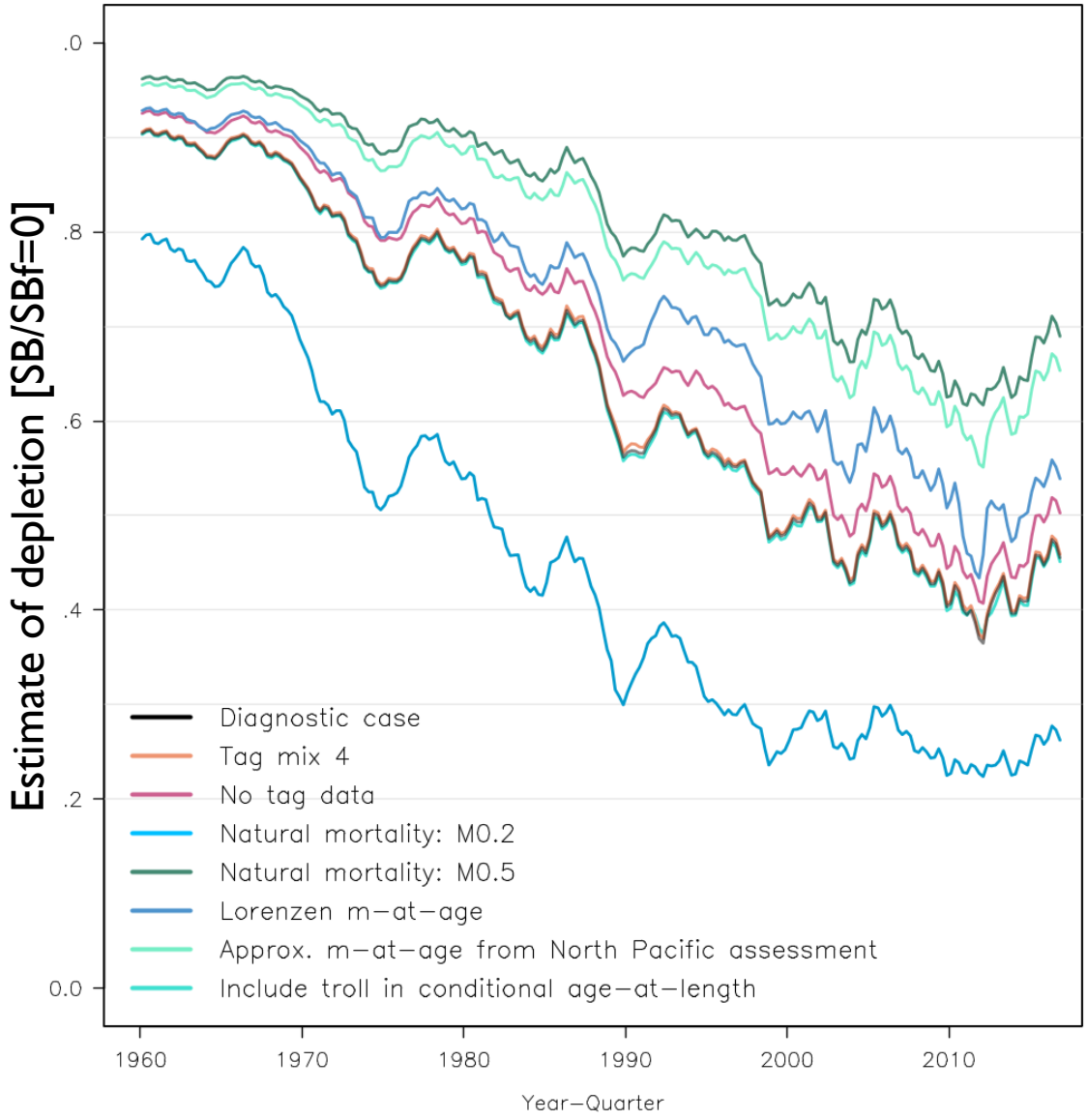

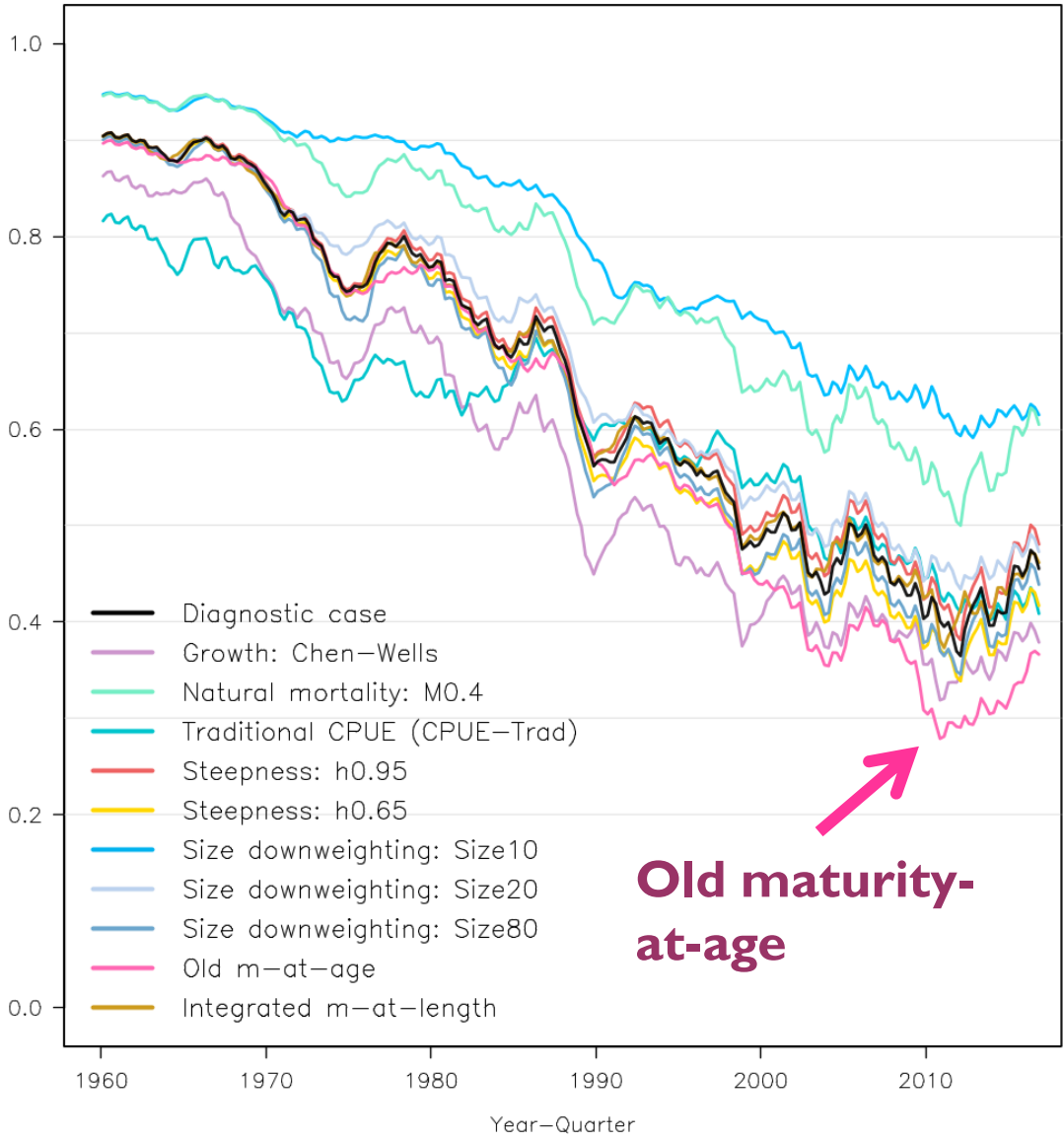

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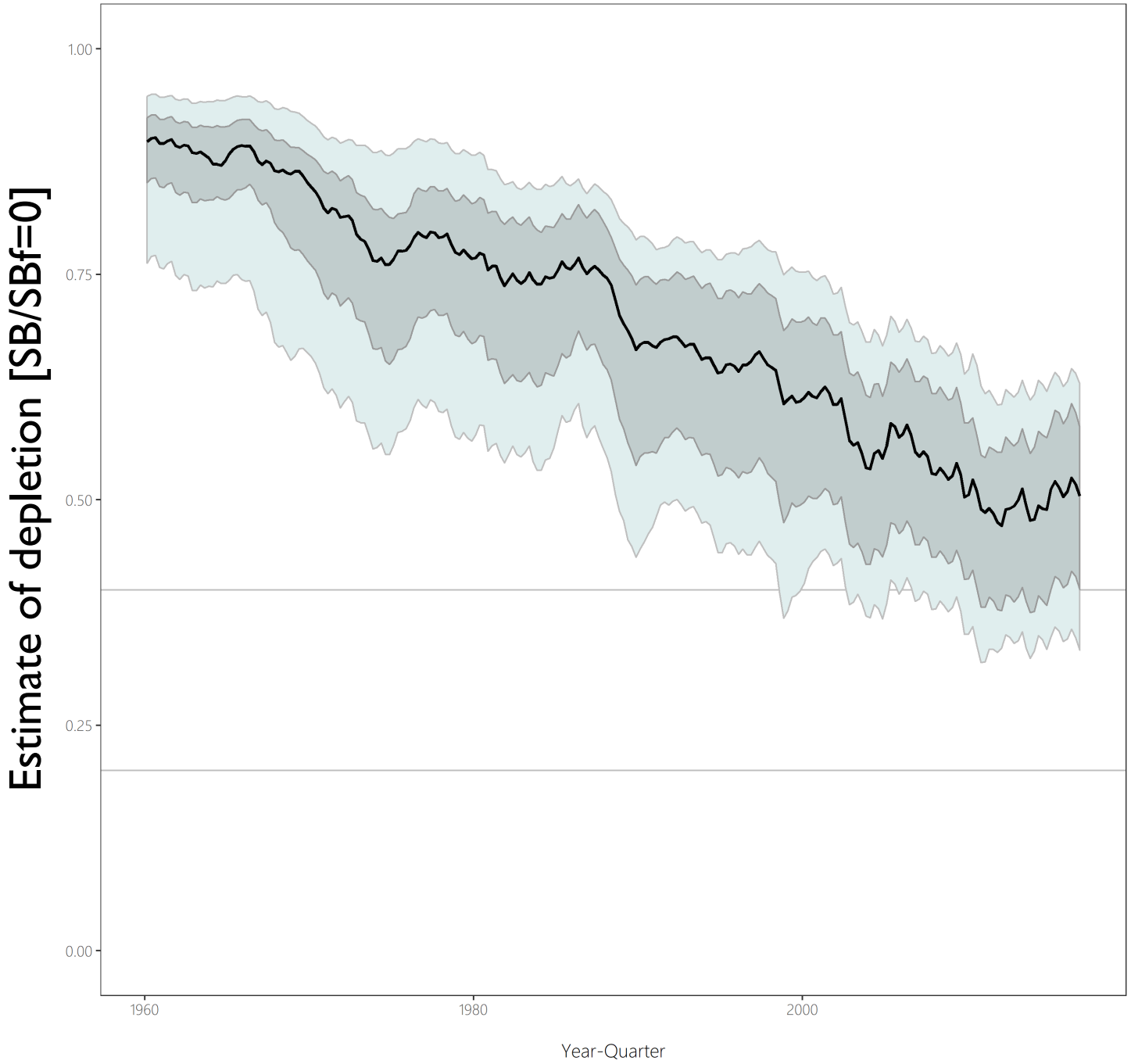
STRUCTURAL UNCERTAINTY GRID

- Natural mortality *m* (0.3, 0.4)
- Growth (estimated, fixed at Chen-Wells VB)
- CPUE (traditional, geostatistical)
- Divisor on the size weighting (20, 50, 80)
- Steepness (0.65, 0.8, 0.95)

→ 72 model runs

+ note revised grid in Rev2 paper

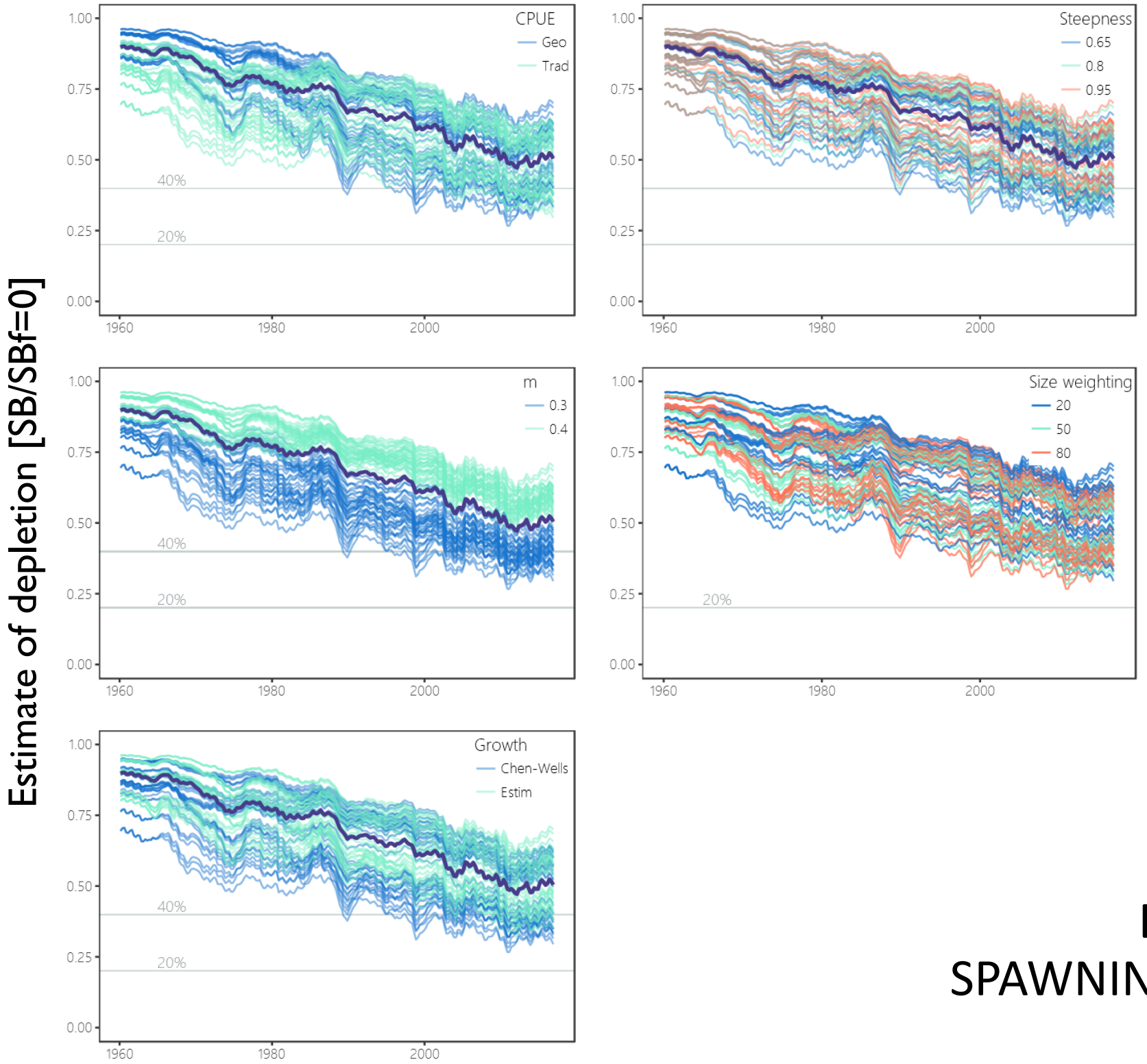
DEPLETION IN SPAWNING POTENTIAL



90th quantile range

50th quantile range

median



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DEPLETION IN SPAWNING POTENTIAL

Influential axis 1: Natural mortality

High value implies more productive stock

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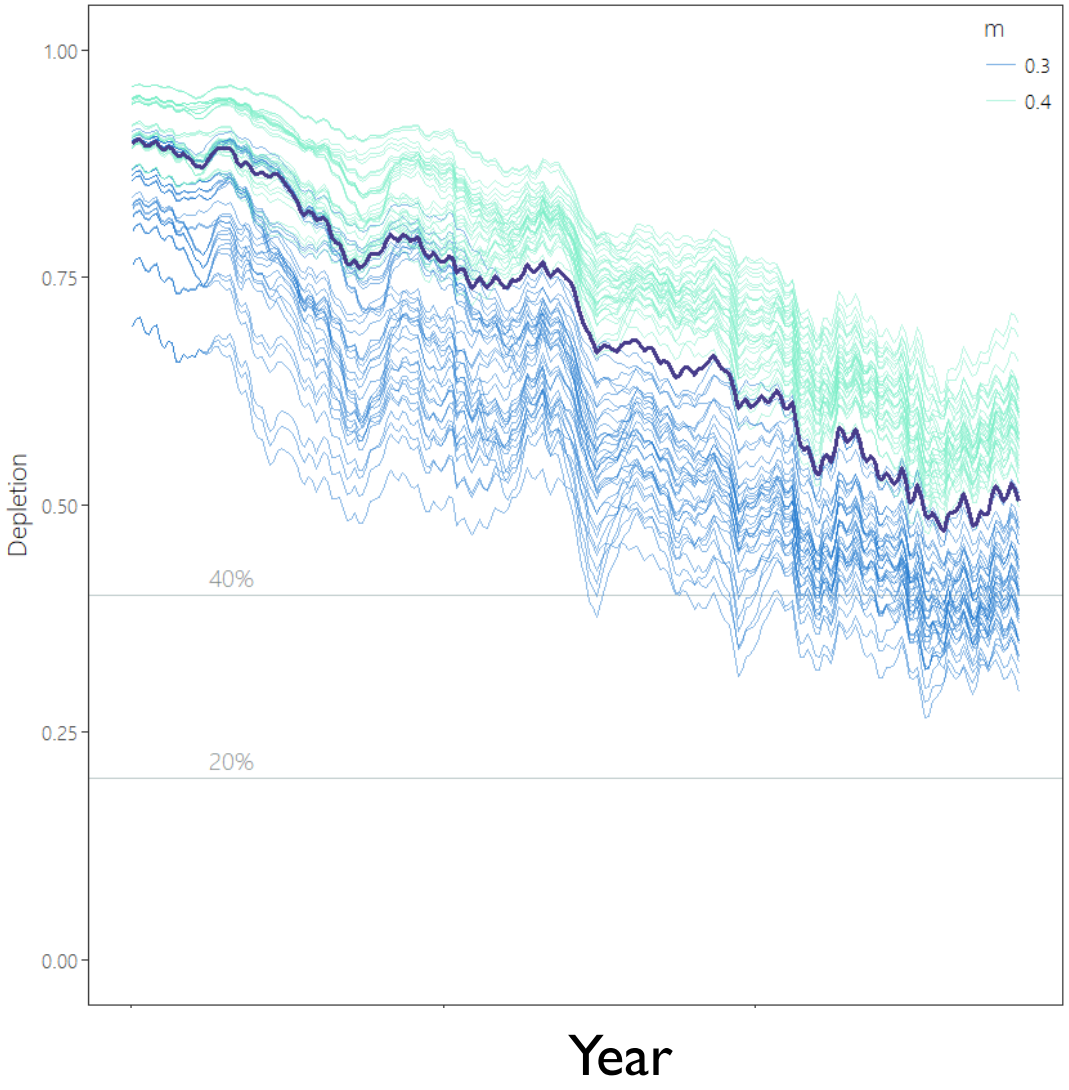
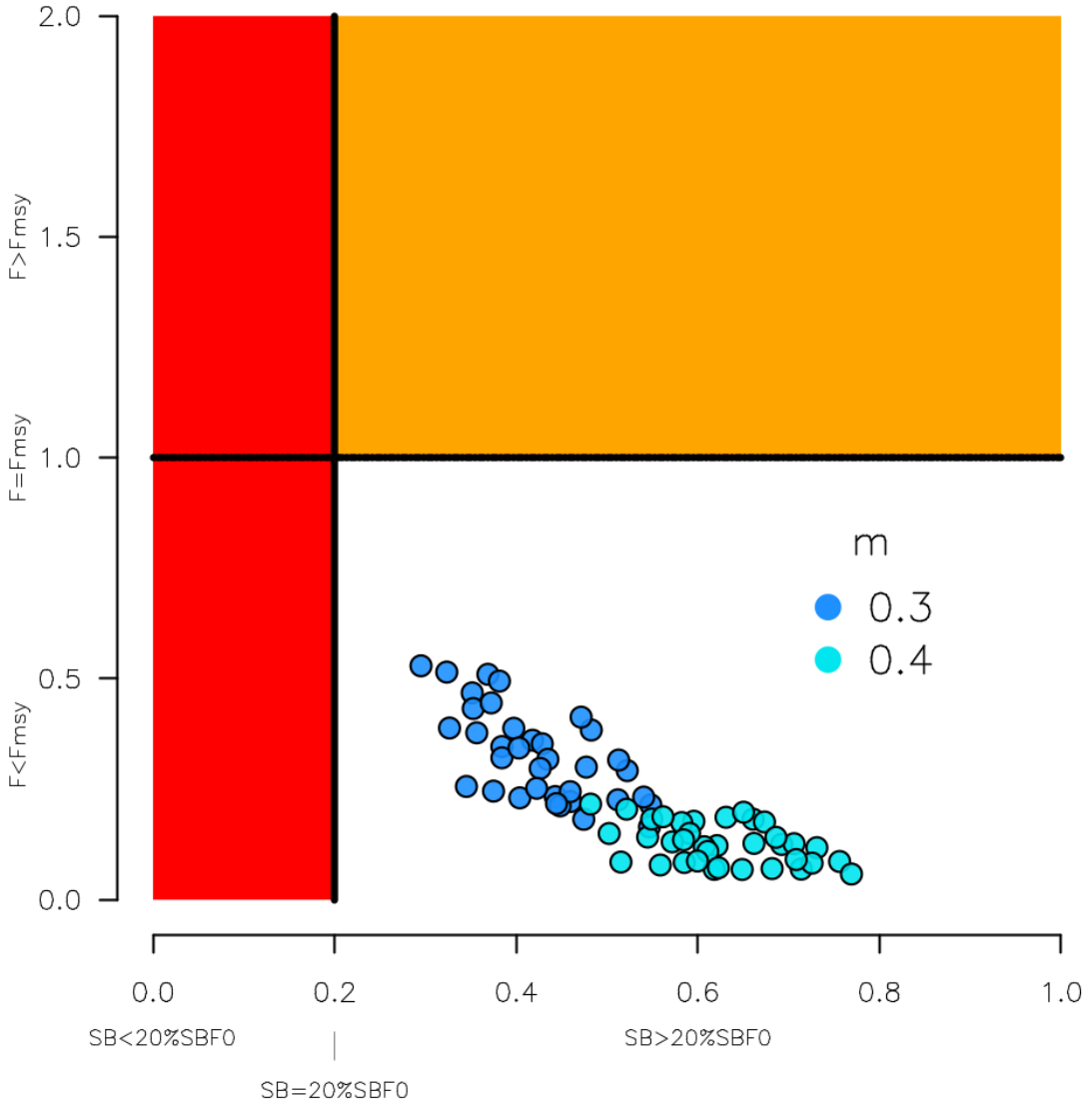
Depletion by run over time



Majuro



Influential axis 2: Growth

Fixed (Chen-Wells) vs. estimated

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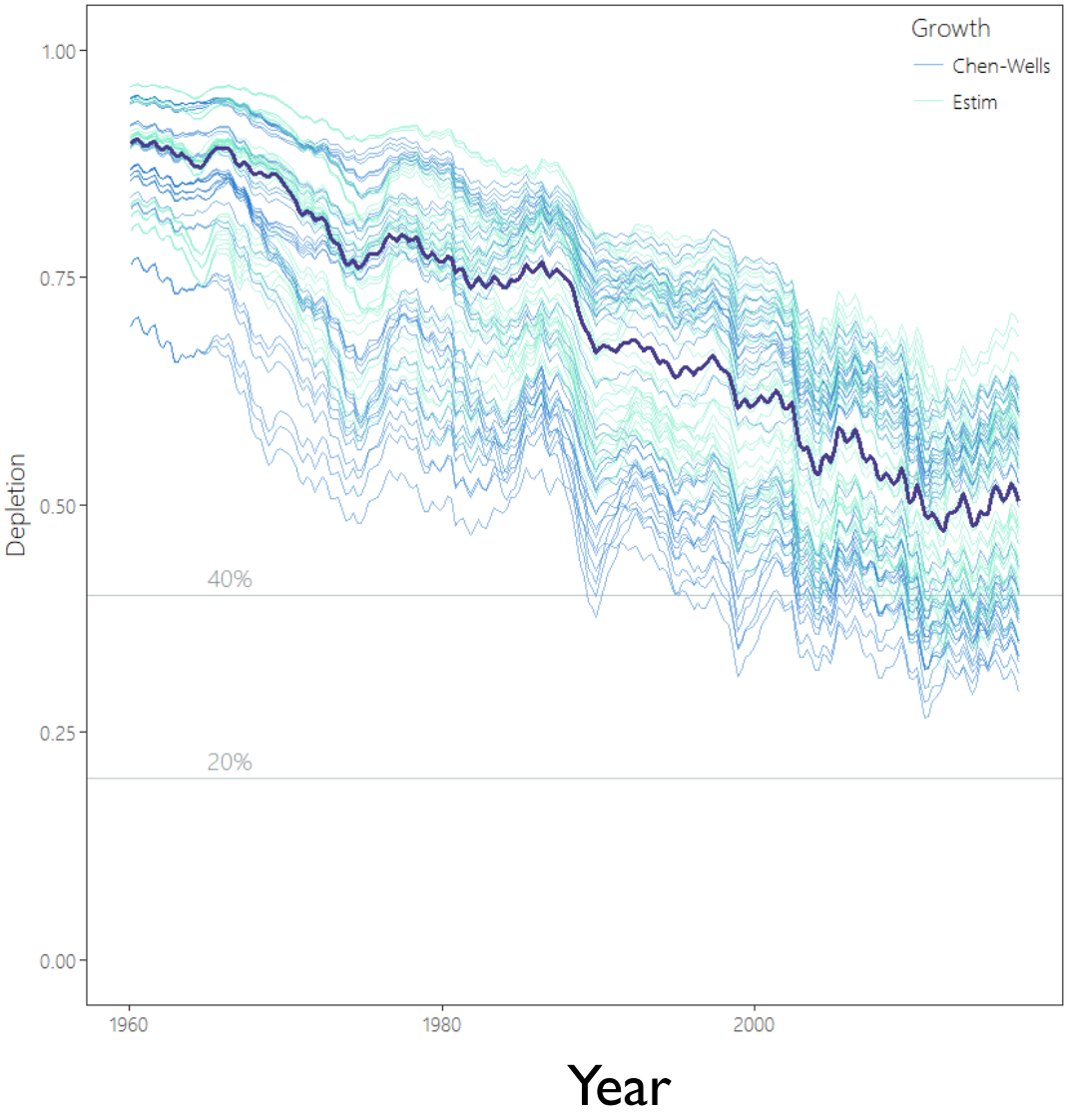
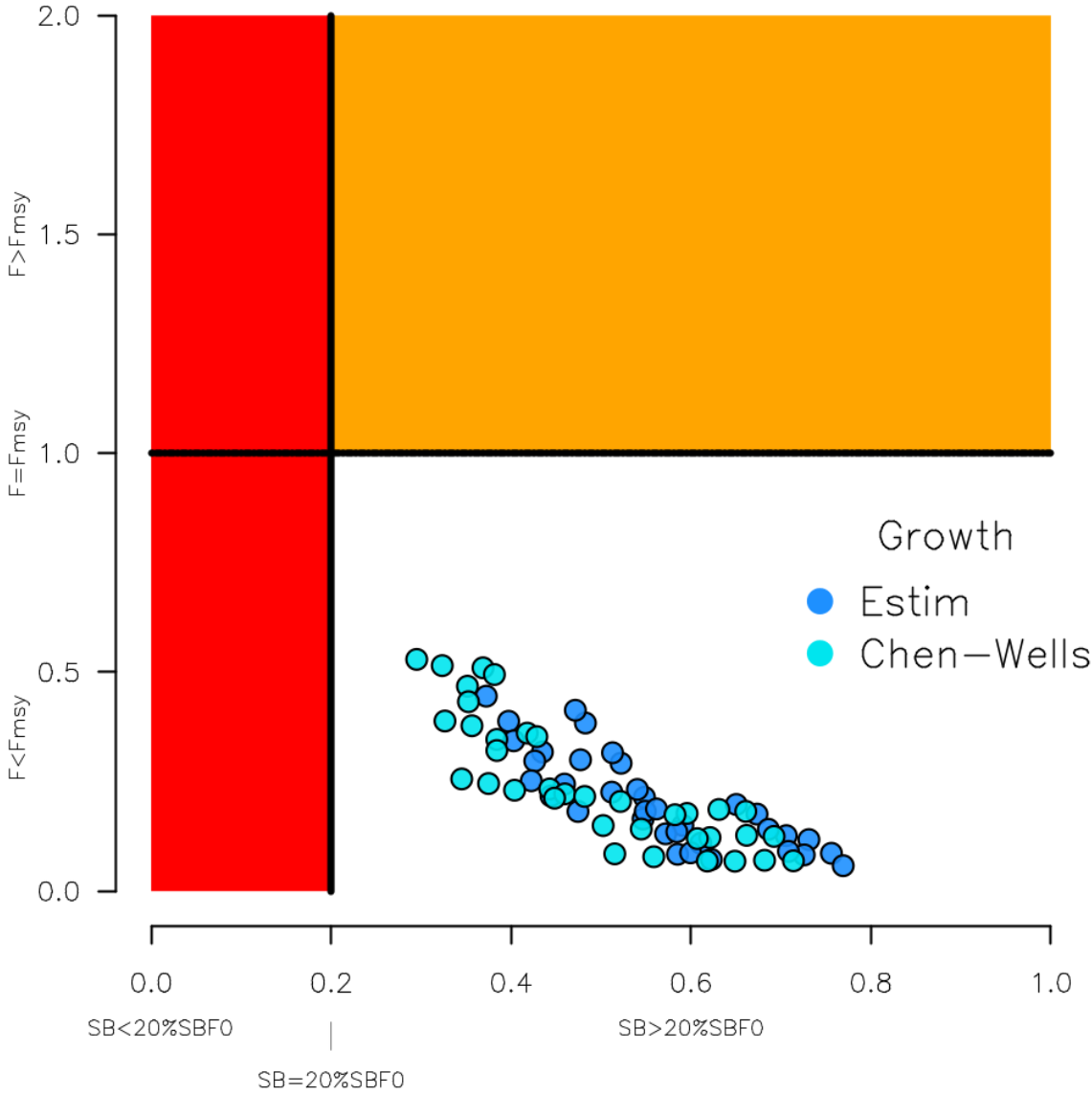
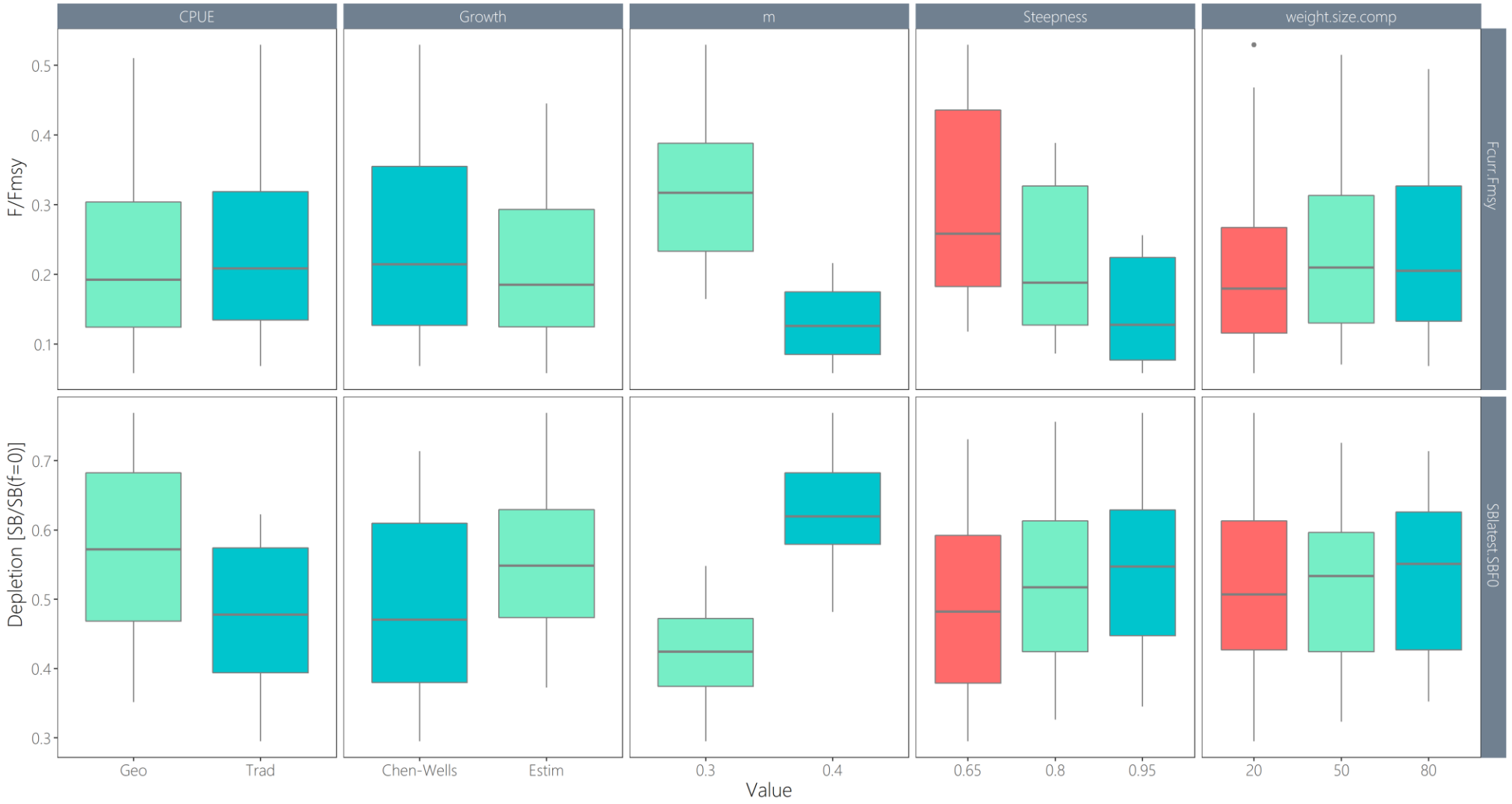


Majuro



GRID SUMMARIES BY AXIS



MAJURO PLOTS FOR THE GRID

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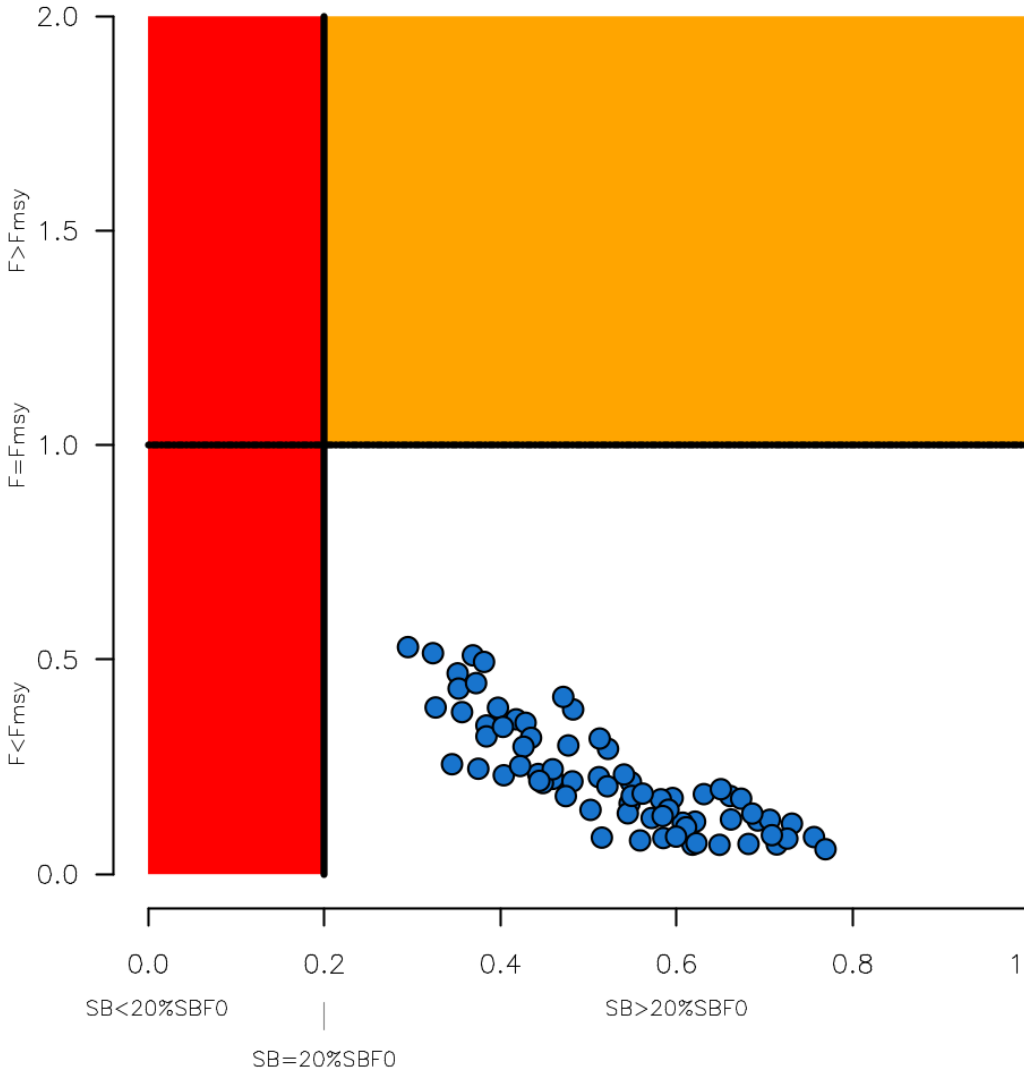
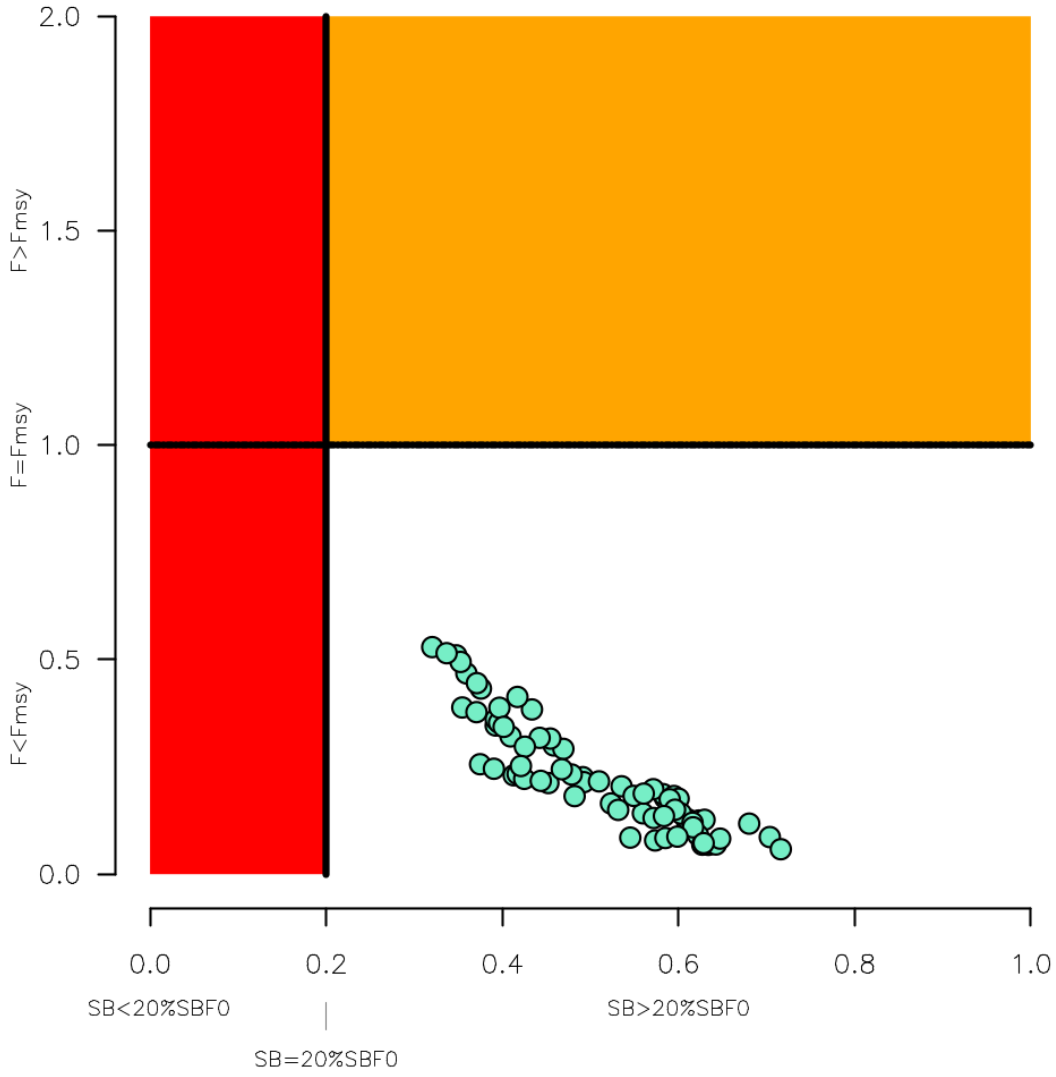
Latest (2016)



Recent (2013-2016)



Summary over entire grid (72 model runs)

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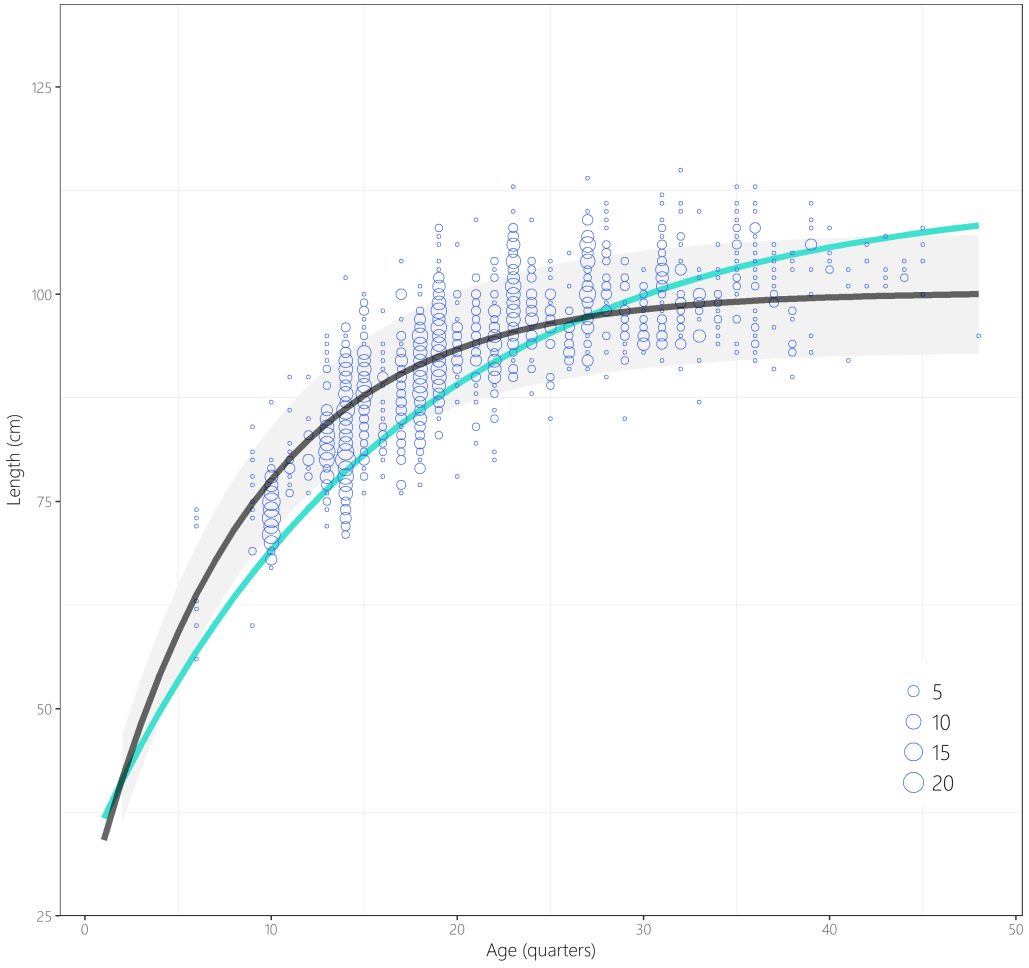
	Mean	Median	Min	10%	90%	Max
C_{latest}	61719	61635	60669	60833	62704	63180
MSY	100074	98080	65040	70856	130220	162000
$YF_{current}$	71579	71780	56680	62480	80432	89000
$fmult$	6.2	4.96	1.89	2.44	12.05	17.18
F_{MSY}	0.07	0.07	0.05	0.05	0.09	0.1
$F_{recent}/F_{\mathrm{MSY}}$	0.23	0.2	0.06	0.08	0.41	0.53
SB_{MSY}	71407	68650	26760	39872	100773	134000
SB_0	443794	439800	308800	353870	510530	696200
SB_{MSY}/SB_0	0.16	0.17	0.07	0.1	0.21	0.23
$SB_{F=0}$	469004	462633	380092	407792	534040	620000
$SB_{\mathrm{MSY}}/SB_{F=0}$	0.15	0.15	0.06	0.09	0.2	0.22
SB_{latest}/SB_0	0.55	0.56	0.33	0.42	0.69	0.74
$SB_{latest}/SB_{F=0}$	0.53	0.52	0.3	0.37	0.69	0.77
$SB_{latest}/SB_{\mathrm{MSY}}$	4	3.42	1.45	1.96	7.07	10.74
$SB_{recent}/SB_{F=0}$	0.51	0.52	0.32	0.37	0.63	0.72
$SB_{recent}/SB_{\mathrm{MSY}}$	3.88	3.3	1.58	1.96	6.56	9.67

CHALLENGES

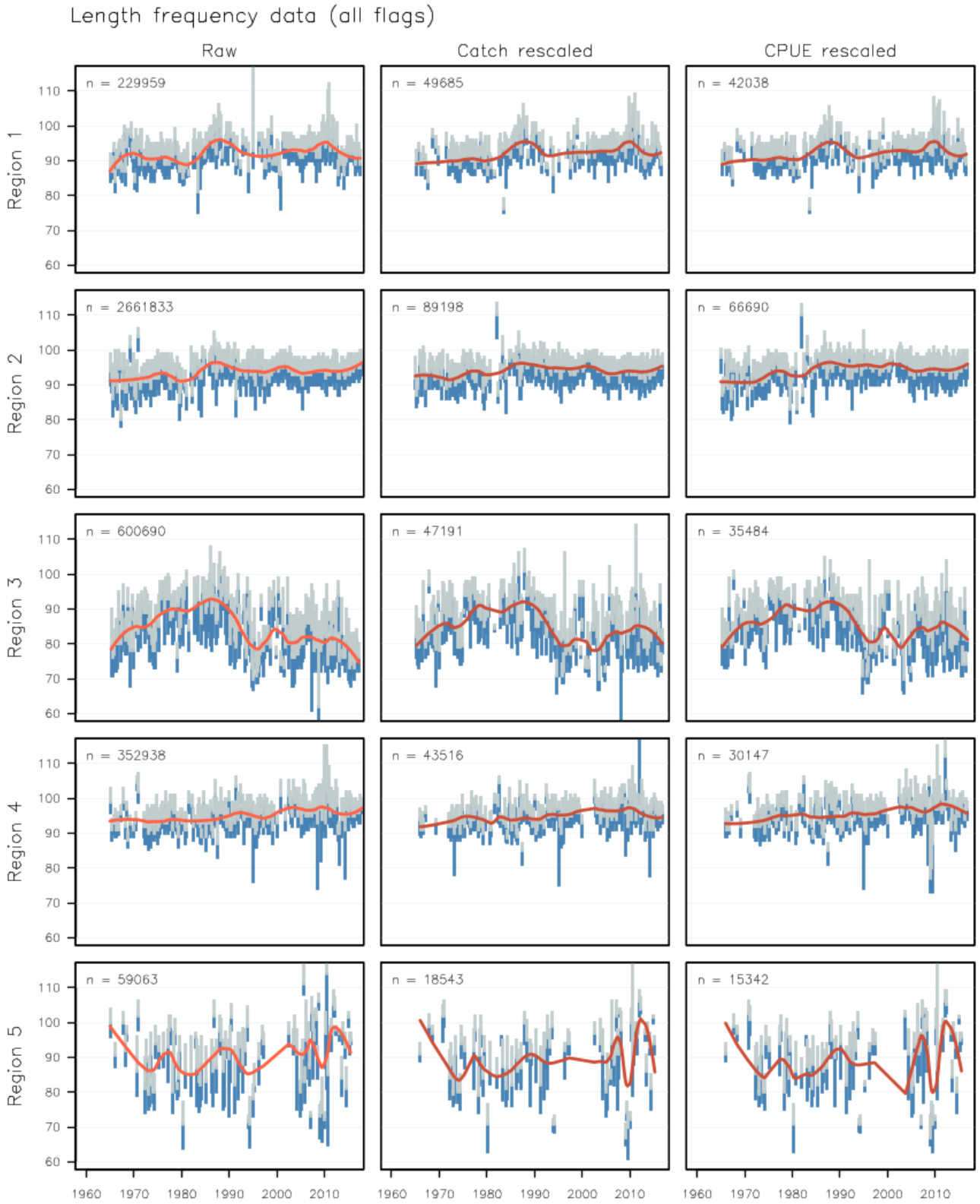
Strong signal in the size data that there is no impact of fishing

vs.

Strong signal in the CPUE data that abundance is declining



REWEIGHTED SIZE DATA (LENGTH)



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CPUE INDICES – TRADITIONAL VS GEOSTATS

CHALLENGES

Strong signal in the size data that there is no impact of fishing

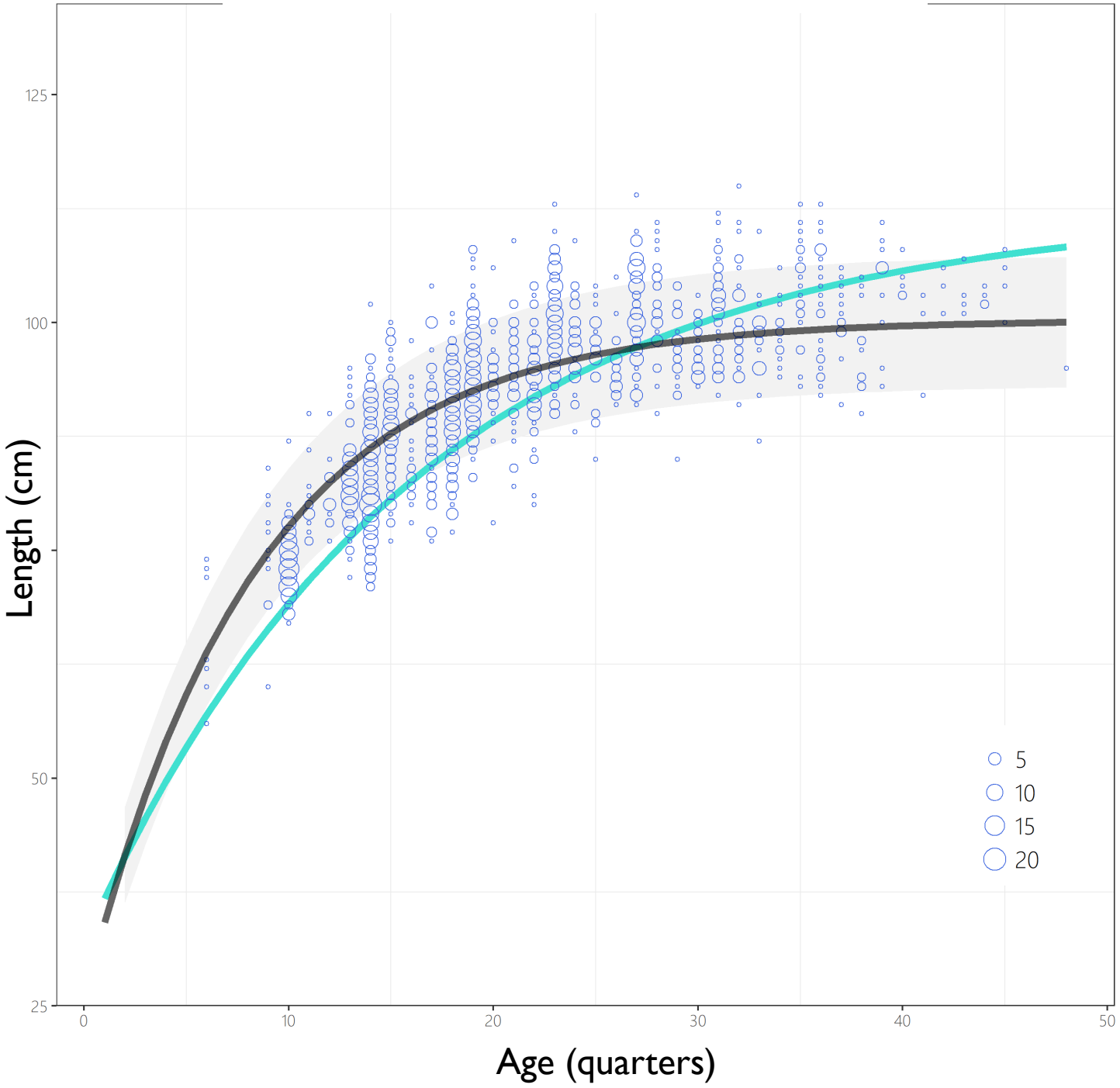
vs.

Strong signal in the CPUE data that abundance is declining

+

slow or fast growth?

GROWTH CURVES AND DATA

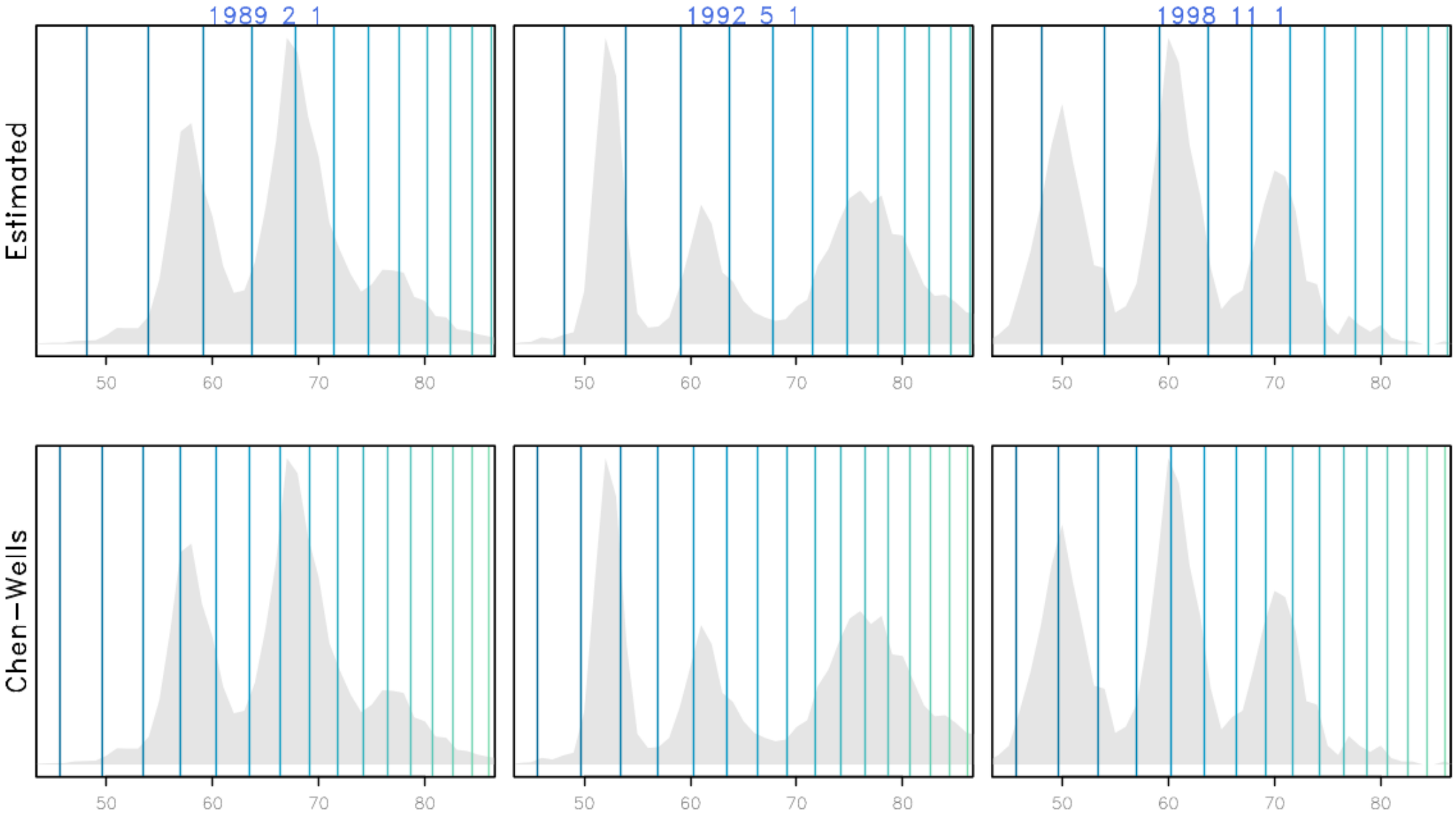


Green = Chen-Wells

Black = estimated

Chen-Wells growth *cf.* Xu et al. (2014)

GROWTH: MIXED SIGNALS



CHALLENGES

Strong signal in the size data that there is no impact of fishing

vs.

Strong signal in the CPUE data that abundance is declining

+

slow or fast growth?

‘slow’ growth in troll modes vs. ‘fast’ growth in the rest of the region (conditional age-length & size data)

→ growth as axis in the structural uncertainty grid

GENERAL DISCUSSION

- Difficult stock to assess as not really “observed” until older, except in surface fisheries
- No reduction in size of fish caught over time
- Uncertainty in growth – otoliths/longline vs. troll data
- Declines in CPUE with large increases in catch not really observed

GENERAL DISCUSSION: GRID

- The grid spans key axes of uncertainty
- Grid predictions very variable but…

  no models suggested overfishing or in an overfished state according to 20% LRP

- Reference points more optimistic than 2015 assessment, but wider range of uncertainty included + updated maturity-at-length increases spawning potential

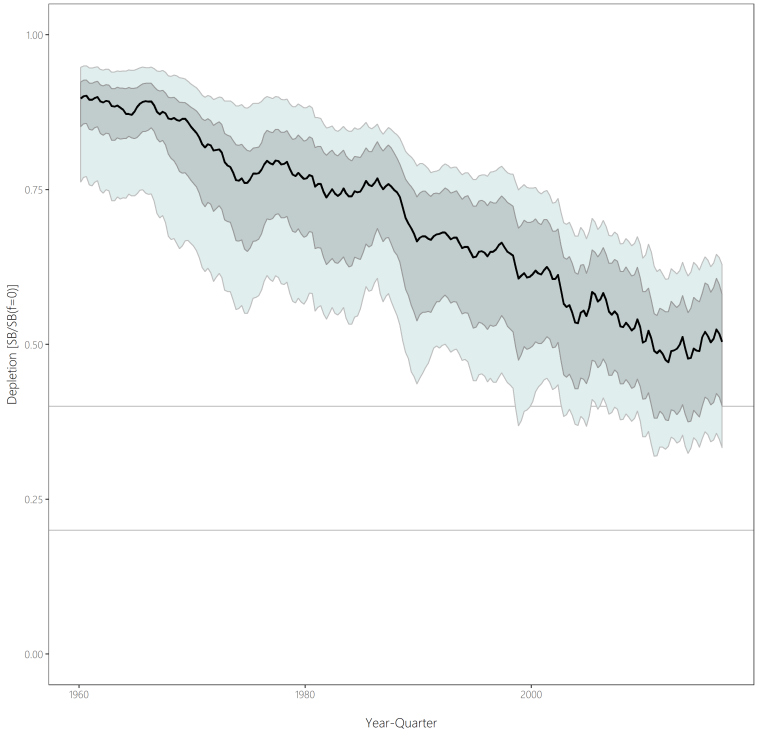
2015 ‘base case’ used for management advice

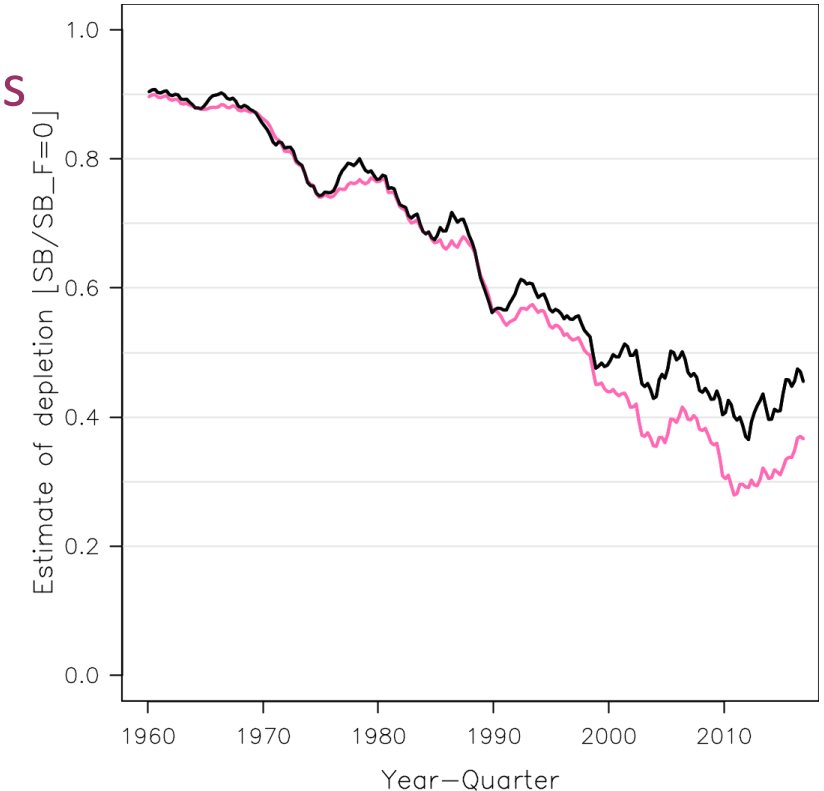
$SB/SB_{F=0} = 0.40^*$

2018 grid subset with $m = 0.3$ (36 models)

$SB/SB_{F=0} = 0.42^*$ (full grid: 0.52)

*latest





FUTURE WORK

- Growth:
  - ▷ Alternatives to Von Bertalanffy growth
  - ▷ Increase otolith sampling for smaller individuals in Southern regions
- Investigation into longline selectivity changes across the region accounting for oceanography and size-distribution
- Ongoing refinements to the geostatistical approach to standardizing CPUE (including vessel effects)
- Ongoing research into the weighing of data inputs, especially size data