

Sardine MSE Results Summary

Robert Wildermuth

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```
## -- Attaching packages ----

## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble   3.1.6     v stringr 1.4.0
## v tidyverse 1.2.0     vforcats 0.5.1
## v readr    1.3.1

## Warning: package 'ggplot2' was
## built under R version 4.0.5

## Warning: package 'tibble' was built
## under R version 4.0.5

## Warning: package 'tidyverse' was built
## under R version 4.0.5
```

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## Warning: package 'forcats' was
## built under R version 4.0.5

## -- Conflicts -----
## x purrr::accumulate() masks foreach::accumulate()
## x dplyr::filter()     masks stats::filter()
## x dplyr::lag()        masks stats::lag()
## x purrr::when()       masks foreach::when()

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##   Value.Recr = col_double(),
##   Value.SPRratio = col_double(),
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##  Value.lnSPB = col_double(),
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## cols(
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##  Value.Recr = col_double(),
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## )

## `summarise()` has grouped output
## by 'iteration'. You can override
## using the '.groups' argument.
## `summarise()` has grouped output
## by 'model_run', 'iteration'. You
## can override using the '.groups'
## argument.
## `summarise()` has grouped output

```

```

## by 'model_run', 'iteration',
## 'scenario'. You can override using
## the '.groups' argument.
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## by 'model_run', 'iteration',
## 'scenario'. You can override using
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## can override using the '.groups'
## argument.

## # A tibble: 2,400 x 20
## # Groups:   iteration [100]
##       iteration scenario      nonconvg
##             <int>    <chr>        <int>
## 1            4 constGrow200~     1
## 2            4 constGrow200~     1
## 3            6 constGrow200~     1
## 4            6 constGrow200~     1
## 5            6 constGrow200~     1
## 6            7 constGrow200~     1
## 7            9 constGrow200~     1
## 8            9 constGrow200~     1
## 9            9 constGrow200~     2
## 10           11 constGrow200~    1
## # ... with 2,390 more rows, and 17
## #   more variables: nYrs <dbl>,
## #   frqNonConvg <dbl>,
## #   model_run <chr>, yrsN <int>,
## #   closuresFreq <dbl>,
## #   collapseFreq <dbl>,
## #   bonanzaFreq <dbl>, ...

```

Model Dynamics

Timeseries

Plot timeseries of age1+ biomass, catch, and recruitment

```

## `summarise()` has grouped output
## by 'year', 'model_run',
## 'iteration'. You can override
## using the '.groups' argument.

```

Biomass

Plots of simulated (OM) biomass of age 1+ fish with 90% confidence intervals (grey band), and individual trajectories (dotted lines). Under a no fishing strategy:

- * Biomass recovers in the random and cyclic PDO recruitment scenarios
- * Cyclic PDO doesn't result in same variation as random recruitment
- * The SST recruitment scenario has higher overall biomass and larger variation

```

## `summarise()` has grouped output
## by 'year', 'scenario', 'HCR'. You
## can override using the '.groups'
## argument.

```

```

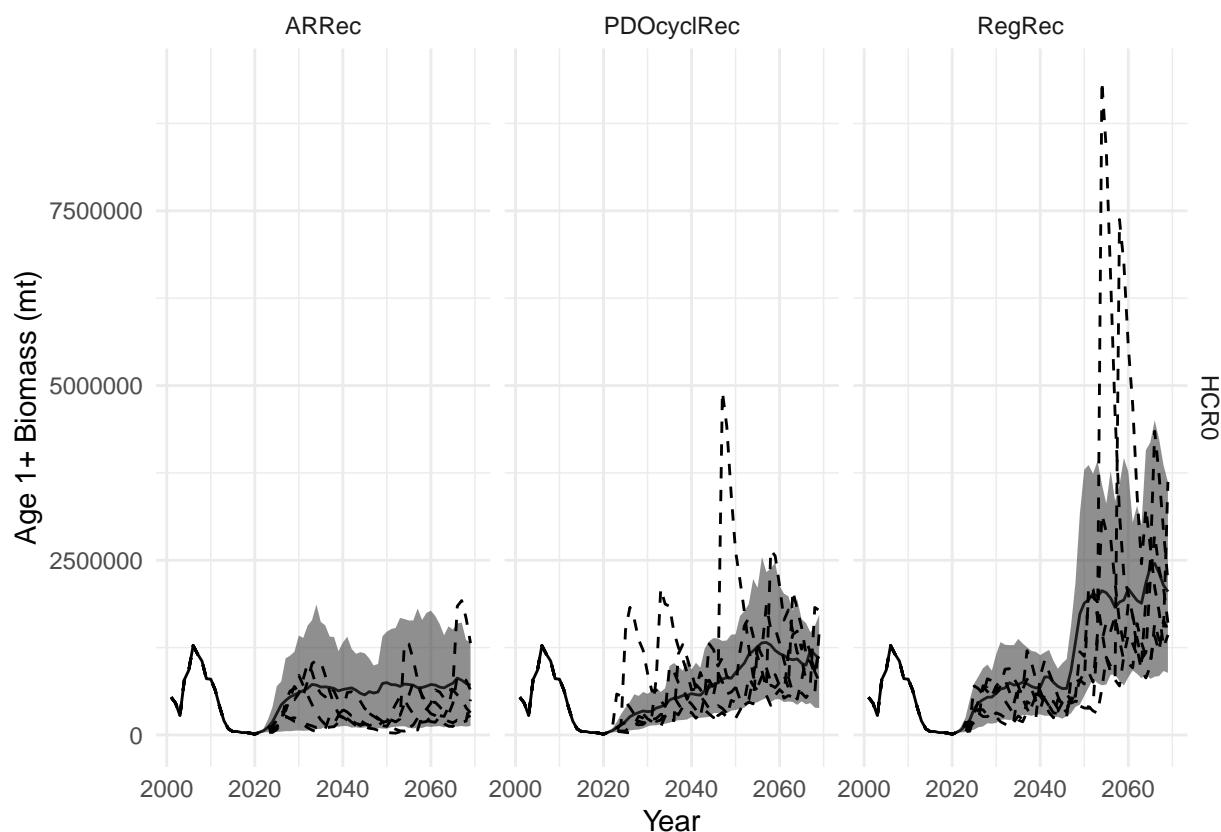
## Warning: Removed 1 row(s)
## containing missing values
## (geom_path).

```

```

## Warning: Removed 5 row(s)
## containing missing values
## (geom_path).

```

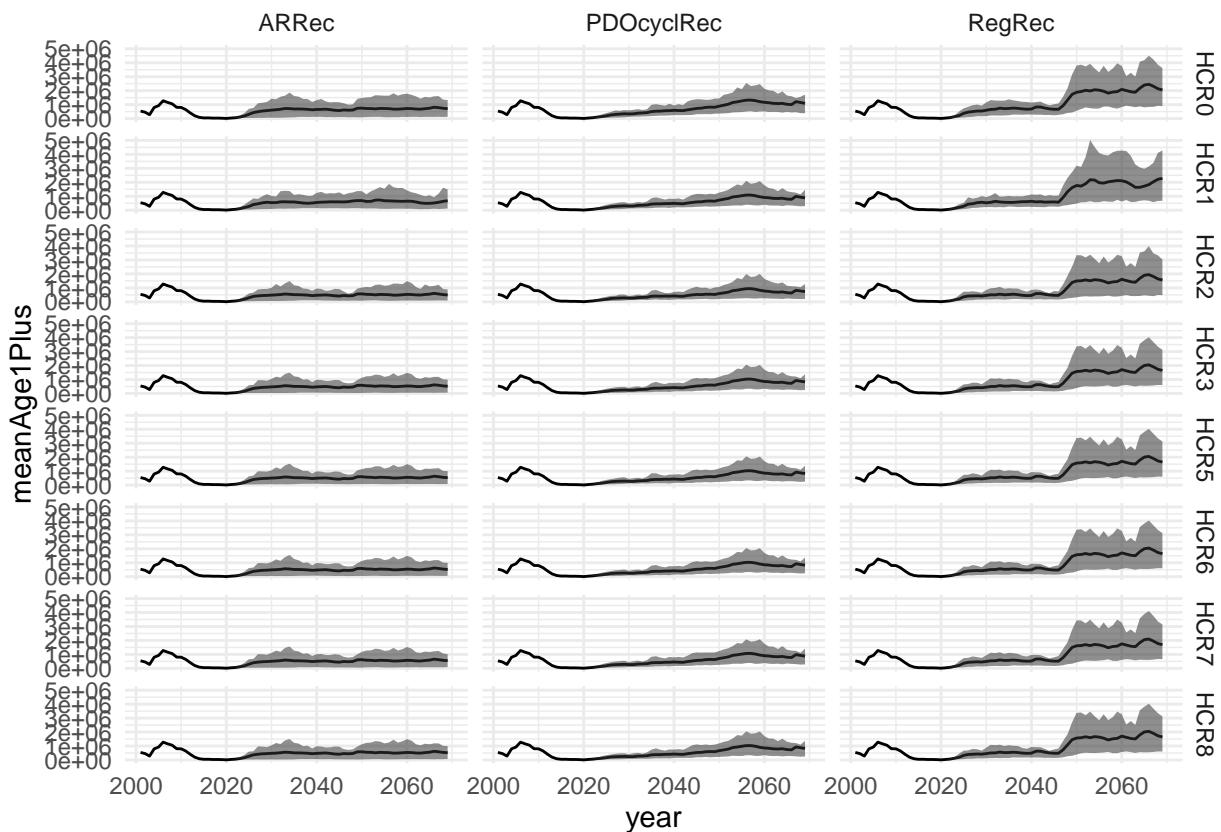


```

## `summarise()` has grouped output
## by 'year', 'scenario', 'HCR'. You
## can override using the '.groups'
## argument.

## Warning: Removed 1 row(s)
## containing missing values
## (geom_path).

```



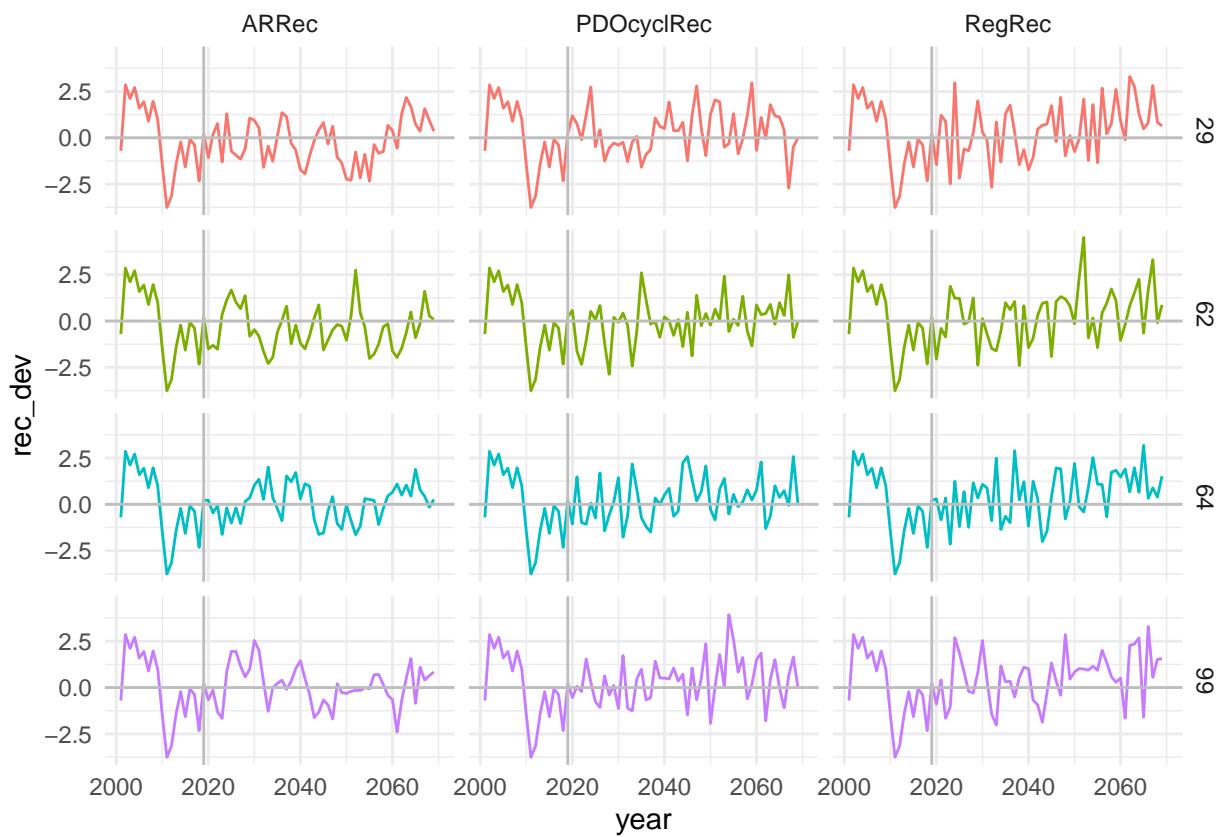
Recruitment

Samples of time series of recruitment deviations from 4 iterations.
 * The SST recruitment scenario is biased positive
 * Leads to much higher recruitment (numbers) overall compared to random recruitment scenario
 * The cyclic PDO scenario doesn't have the same amount of interannual variability as historic or random scenarios, but over the projection period reaches the same distribution as historic recruitment deviations.

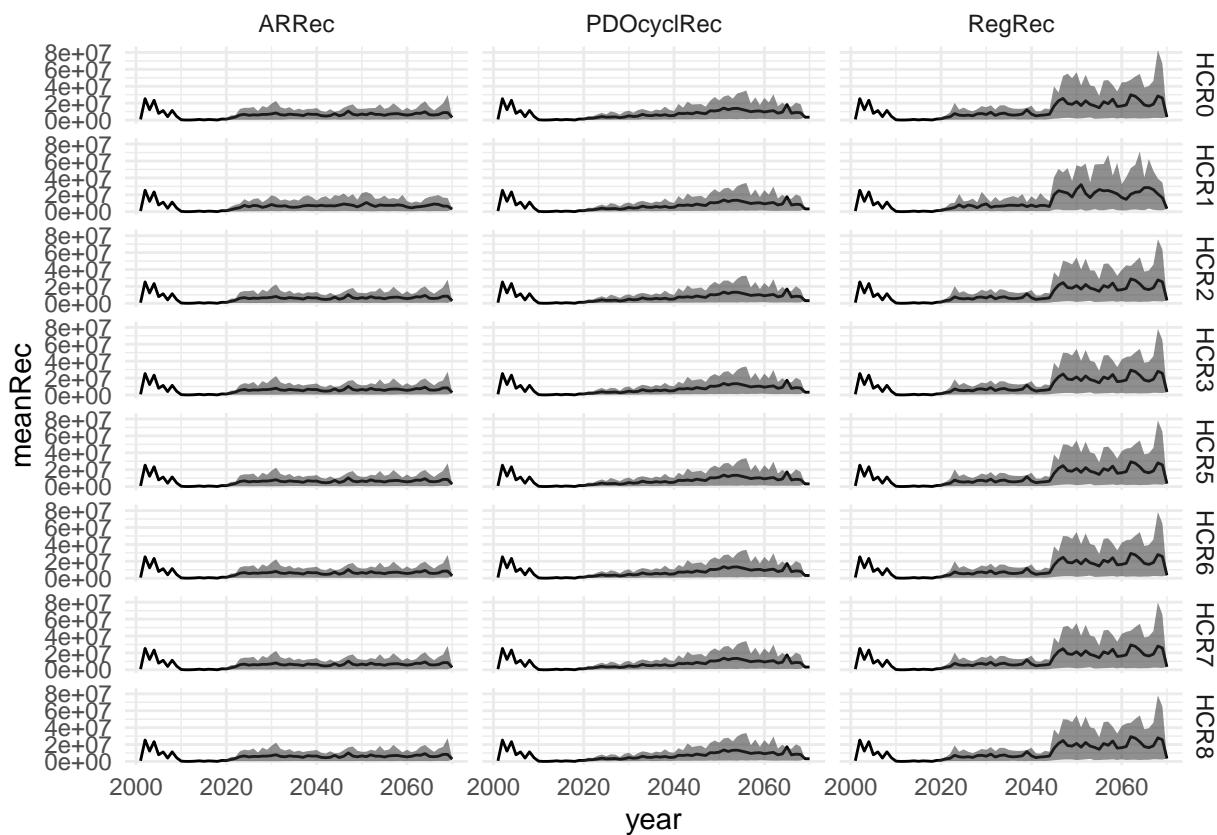
```

## Warning: Removed 4 row(s)
## containing missing values
## (geom_path).

```



```
## `summarise()` has grouped output
## by 'year', 'scenario', 'HCR'. You
## can override using the '.groups'
## argument.
```

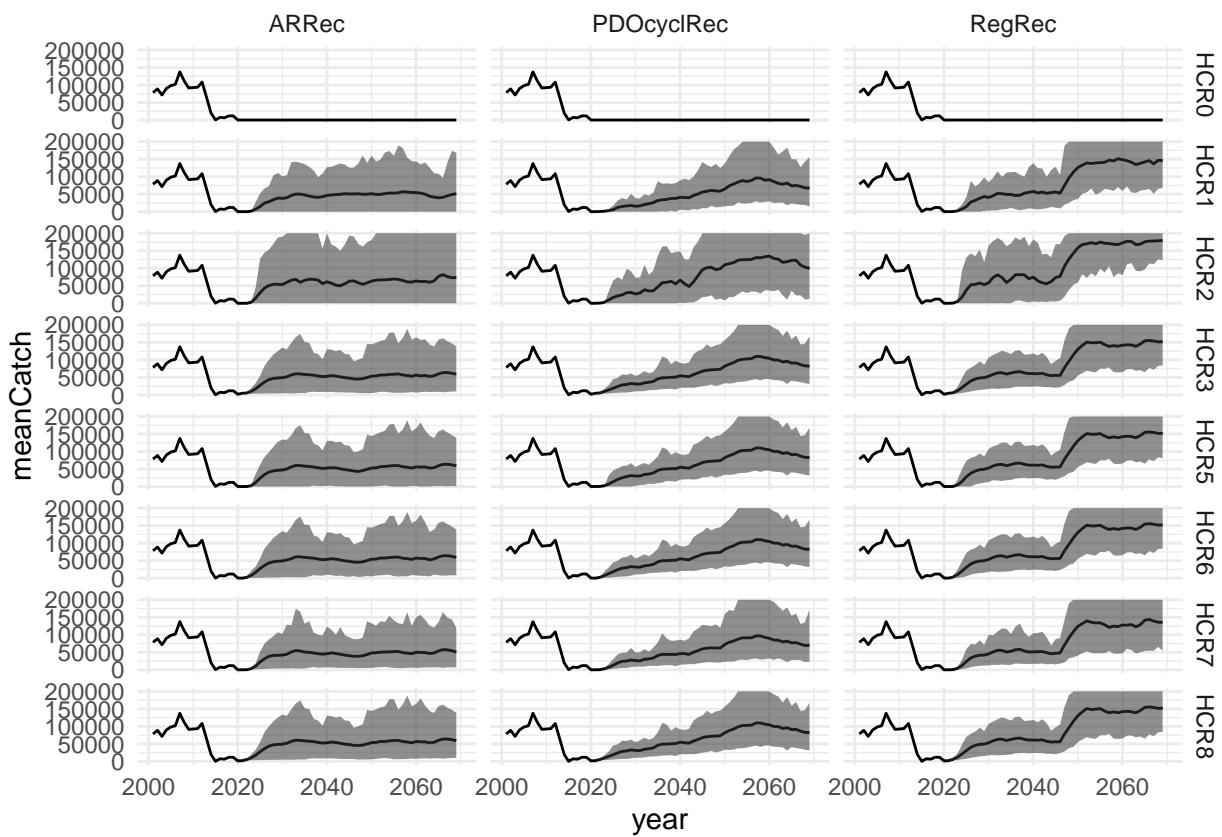


Catch

- Catch recovers more slowly in cyclic PDO scenario
- Catch is higher and more variable in the SST scenario

```
## `summarise()` has grouped output
## by 'year', 'scenario', 'HCR'. You
## can override using the '.groups'
## argument.

## Warning: Removed 1 row(s)
## containing missing values
## (geom_path).
```

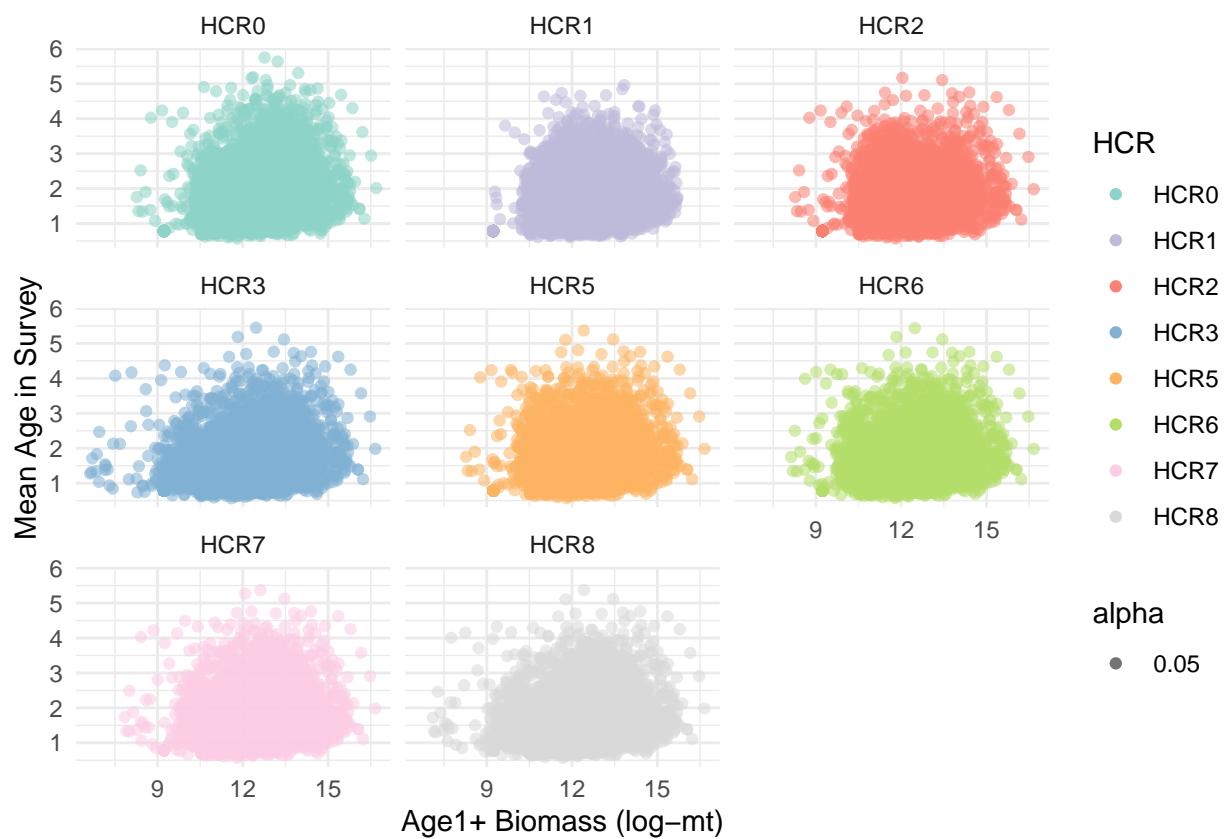


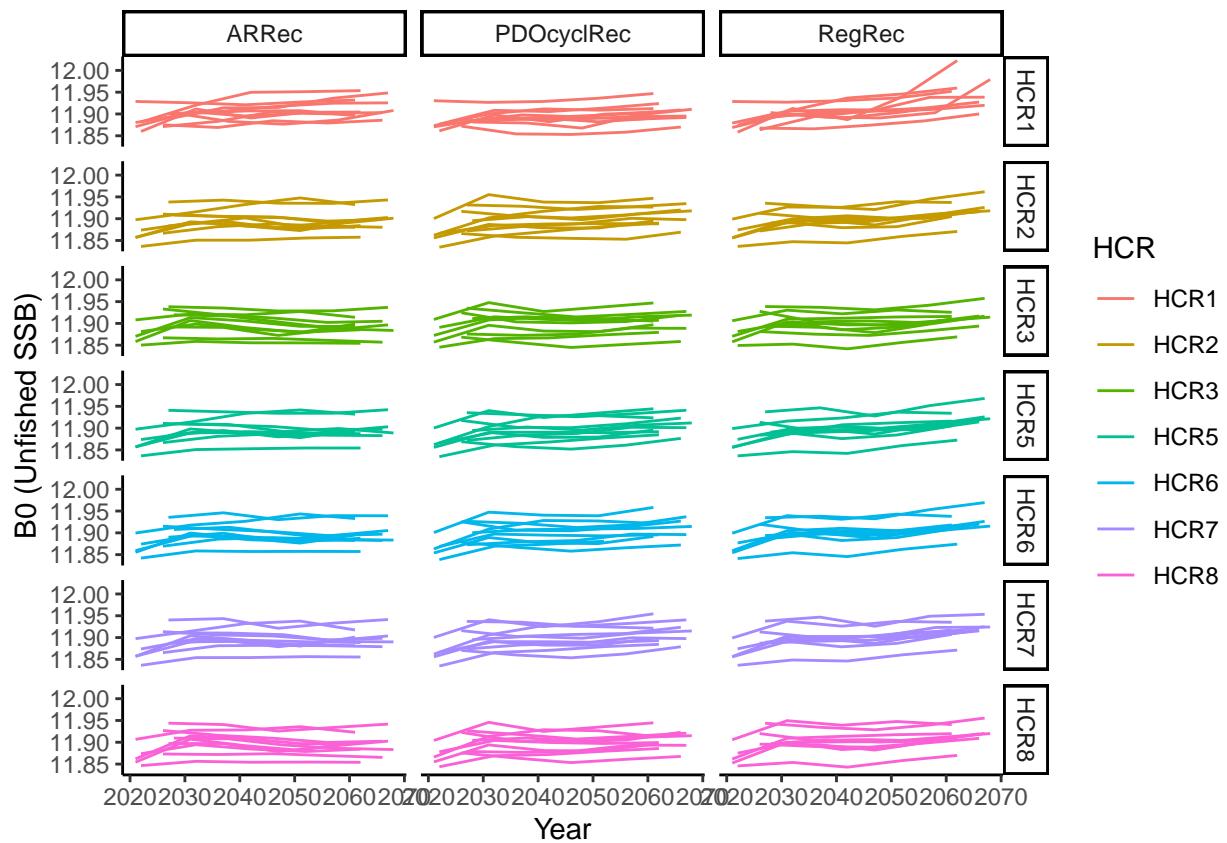
```
## `summarise()` has grouped output
## by 'year', 'scenario', 'HCR'. You
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## argument.
```

Other parameters

- No real trend in mean age, though larger stock biomasses generally allow for potentially older mean ages
- Unfished biomass (B0) estimated to increase as simulation projection progresses under SST recruitment scenario

```
## Warning: Removed 800 rows containing
## missing values (geom_point).
```

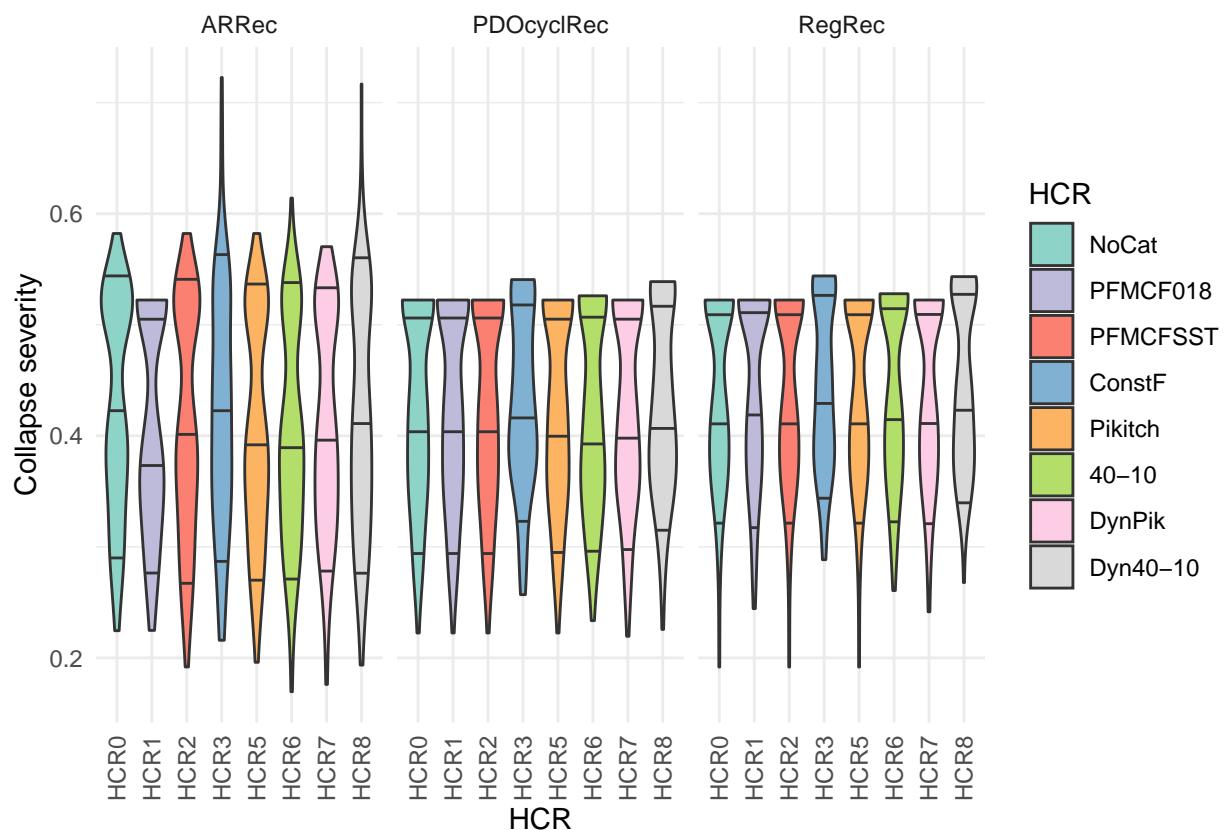
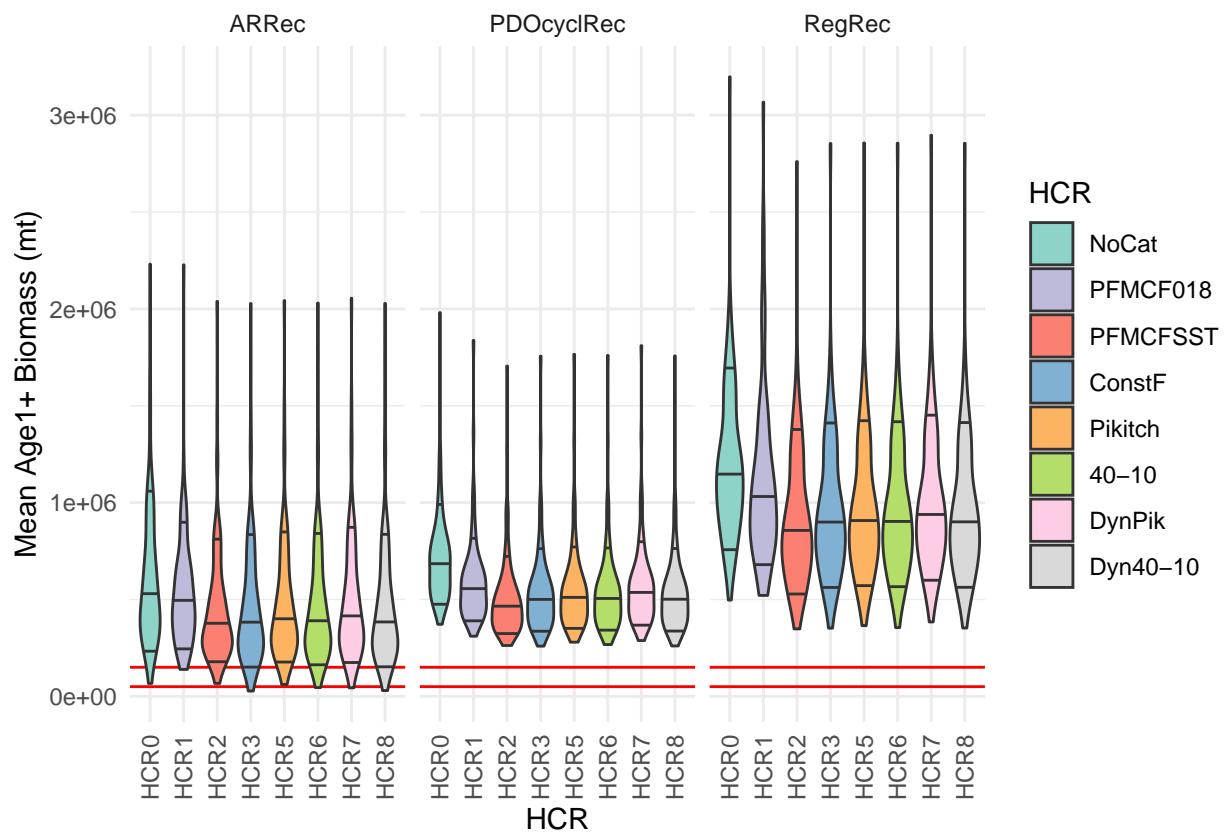


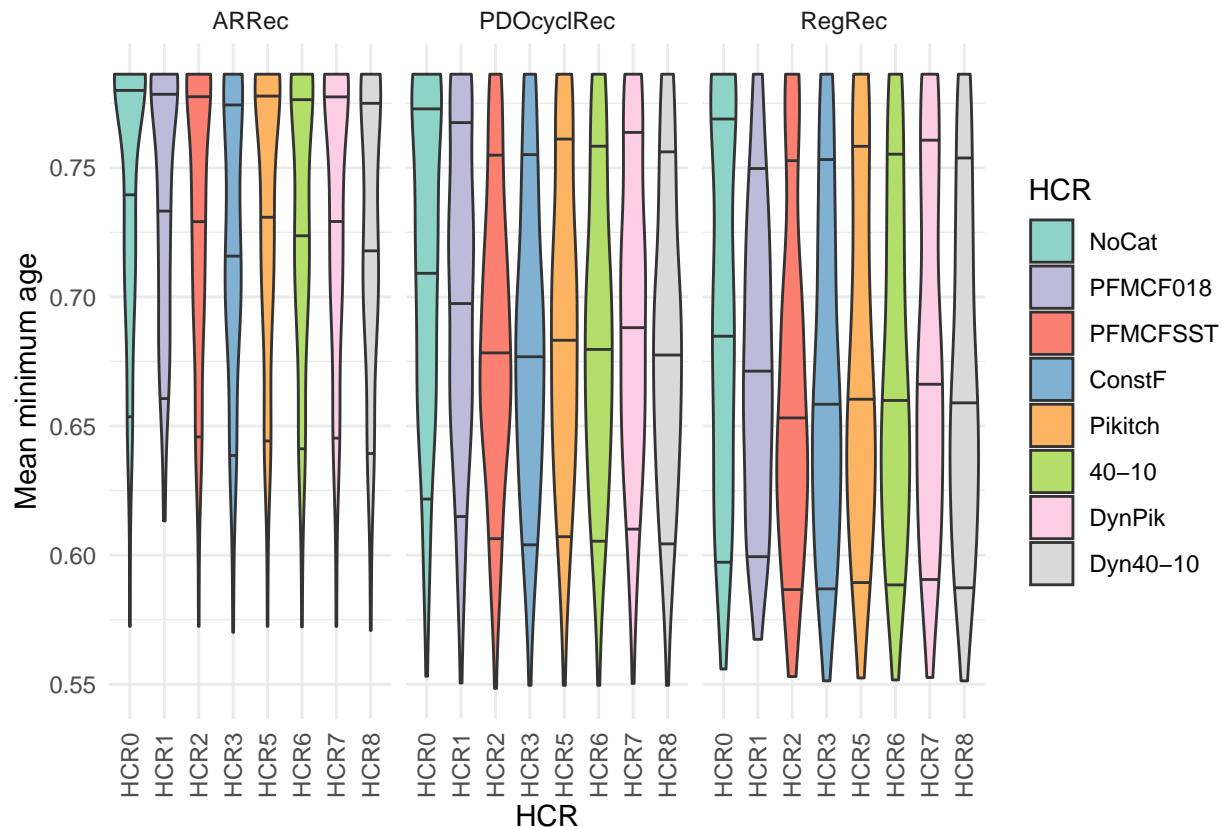


Performance Metrics

Plot comparisons across HCR and Recruitment scenario

Stock Status



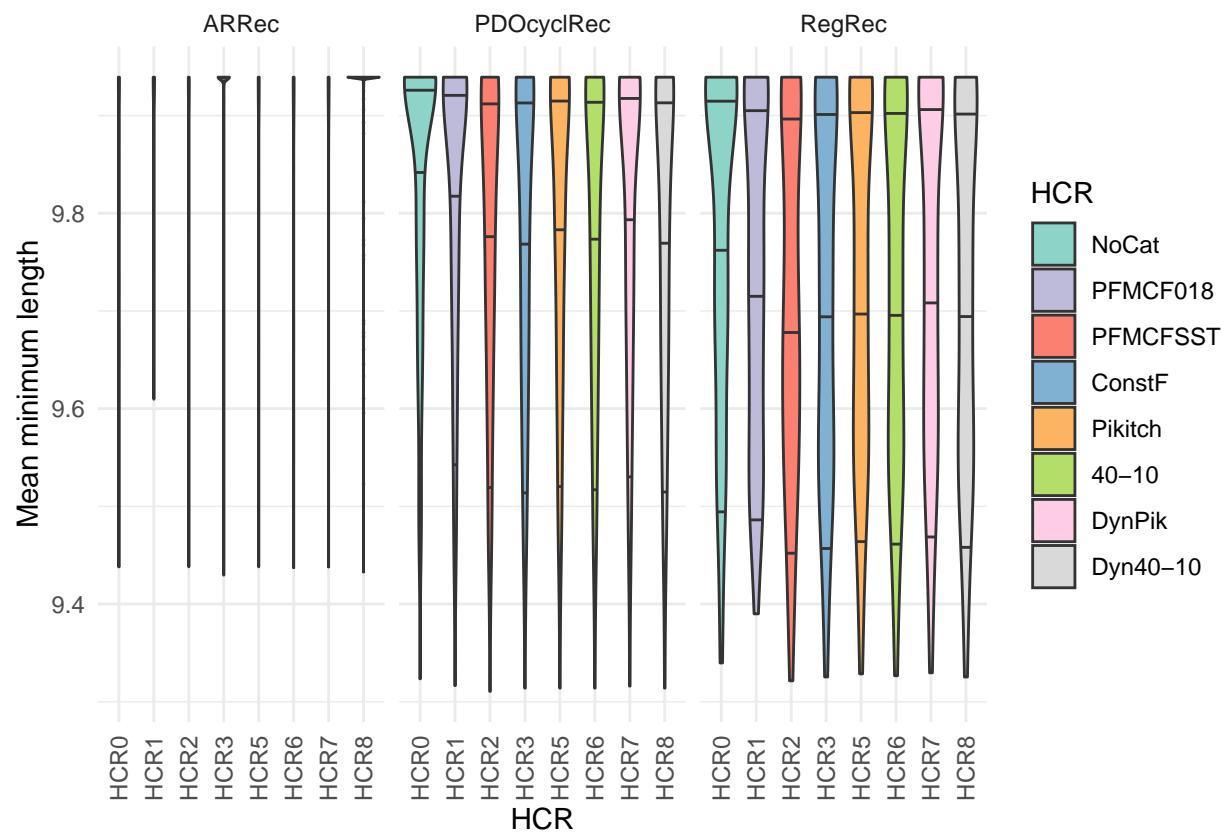


```

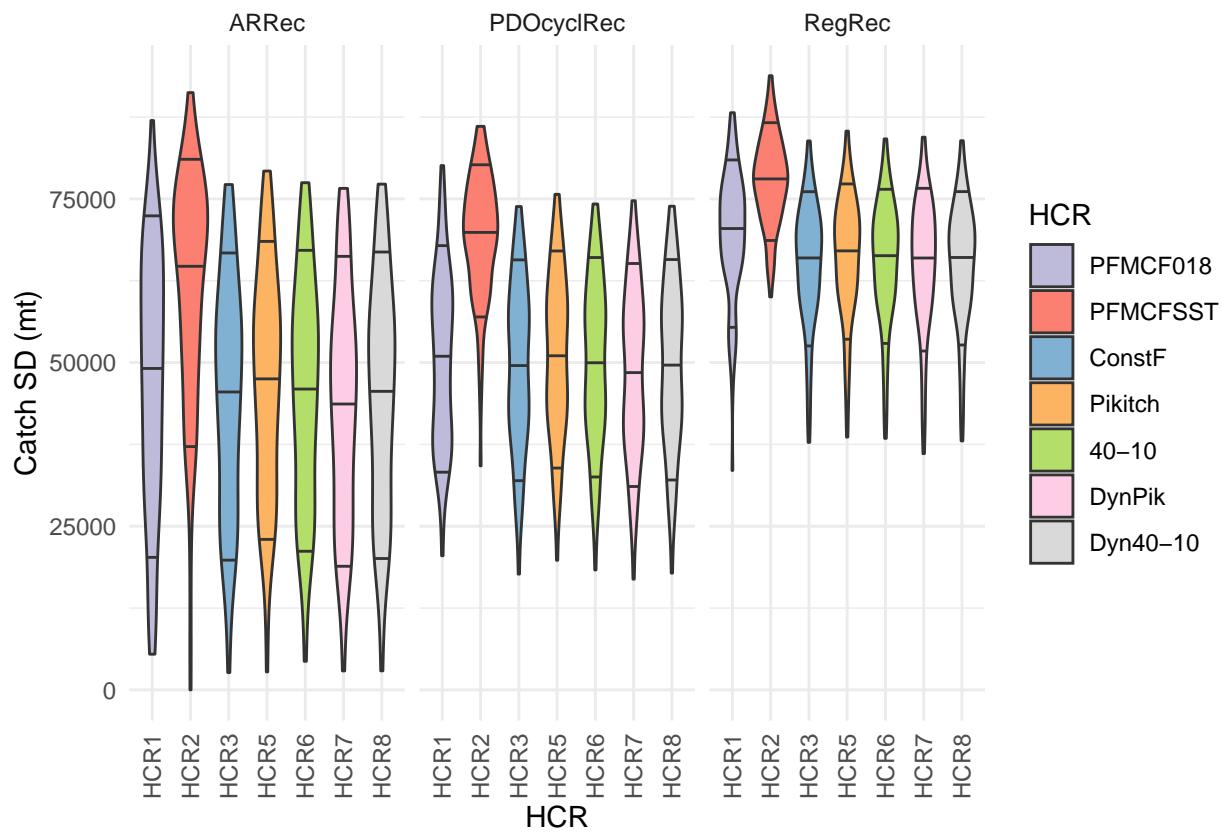
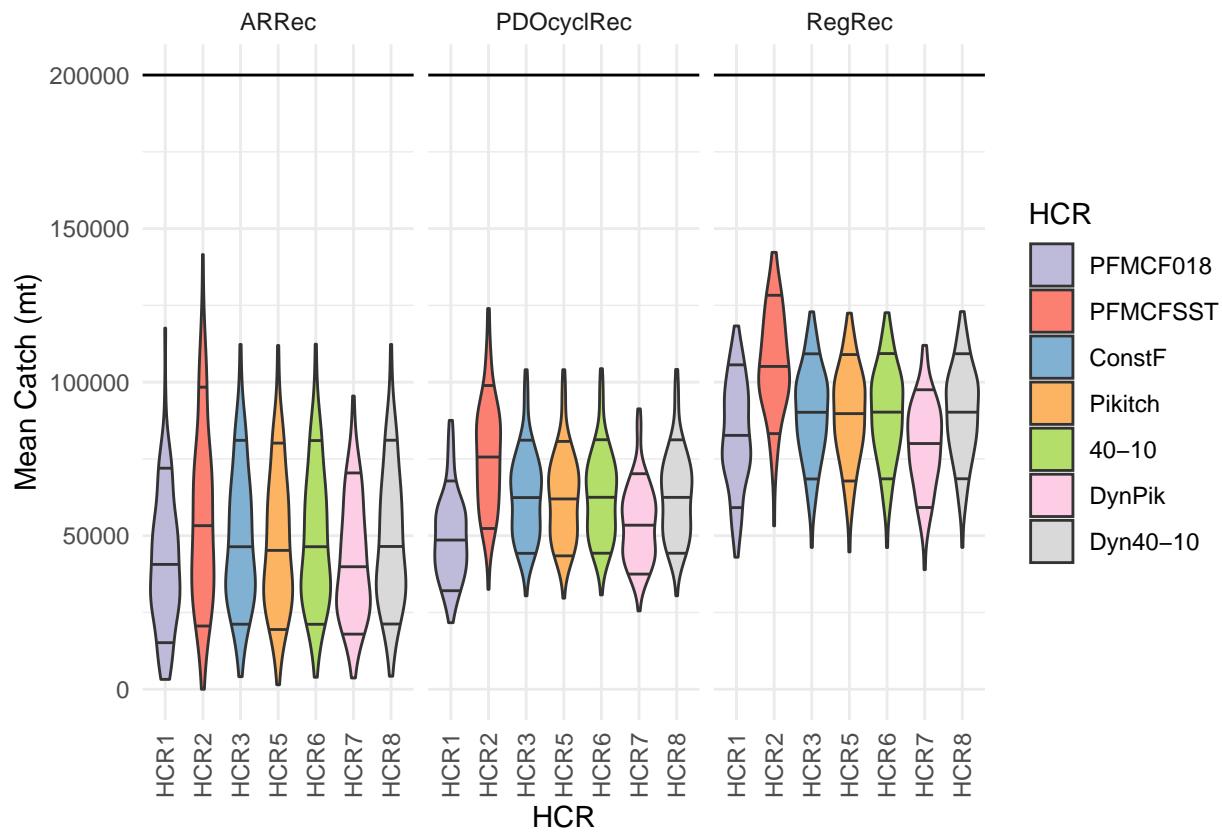
## Warning in regularize.values(x,
## y, ties, missing(ties), na.rm =
## na.rm): collapsing to unique 'x'
## values

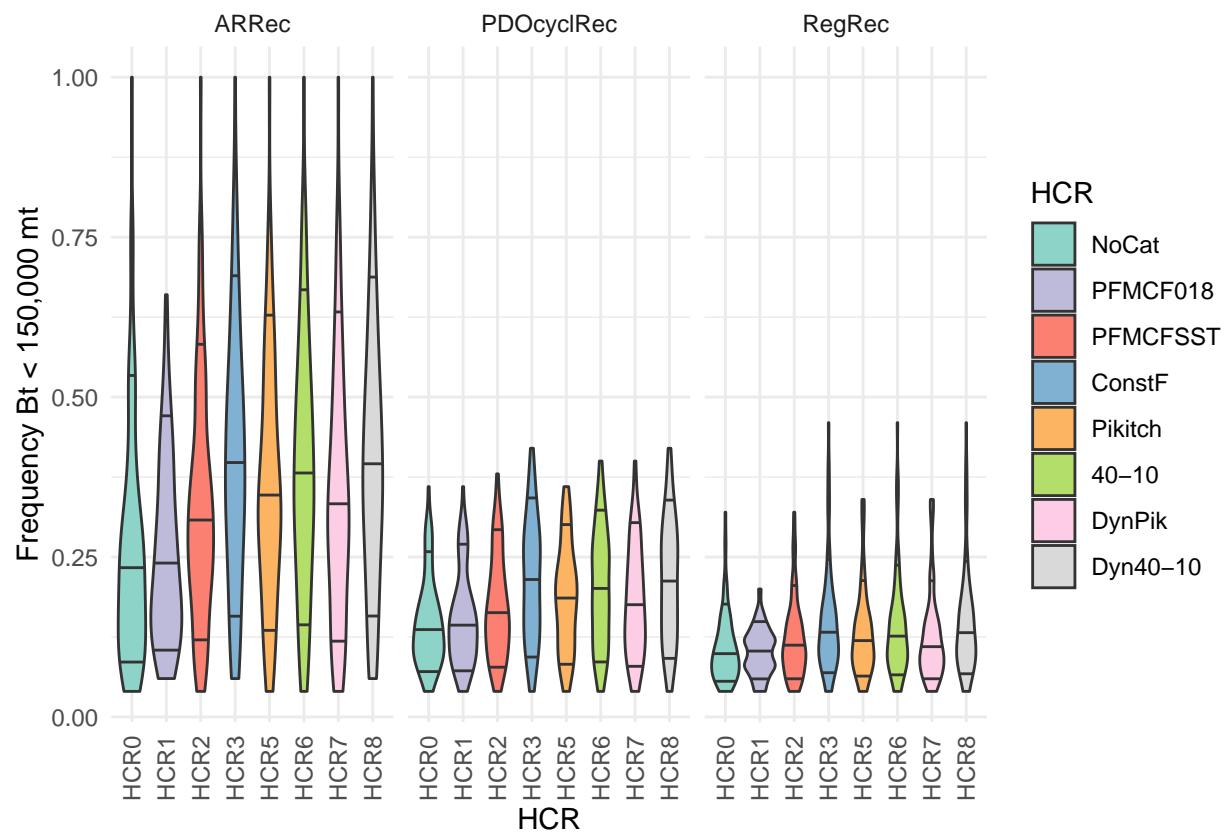
## Warning in regularize.values(x,
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## values

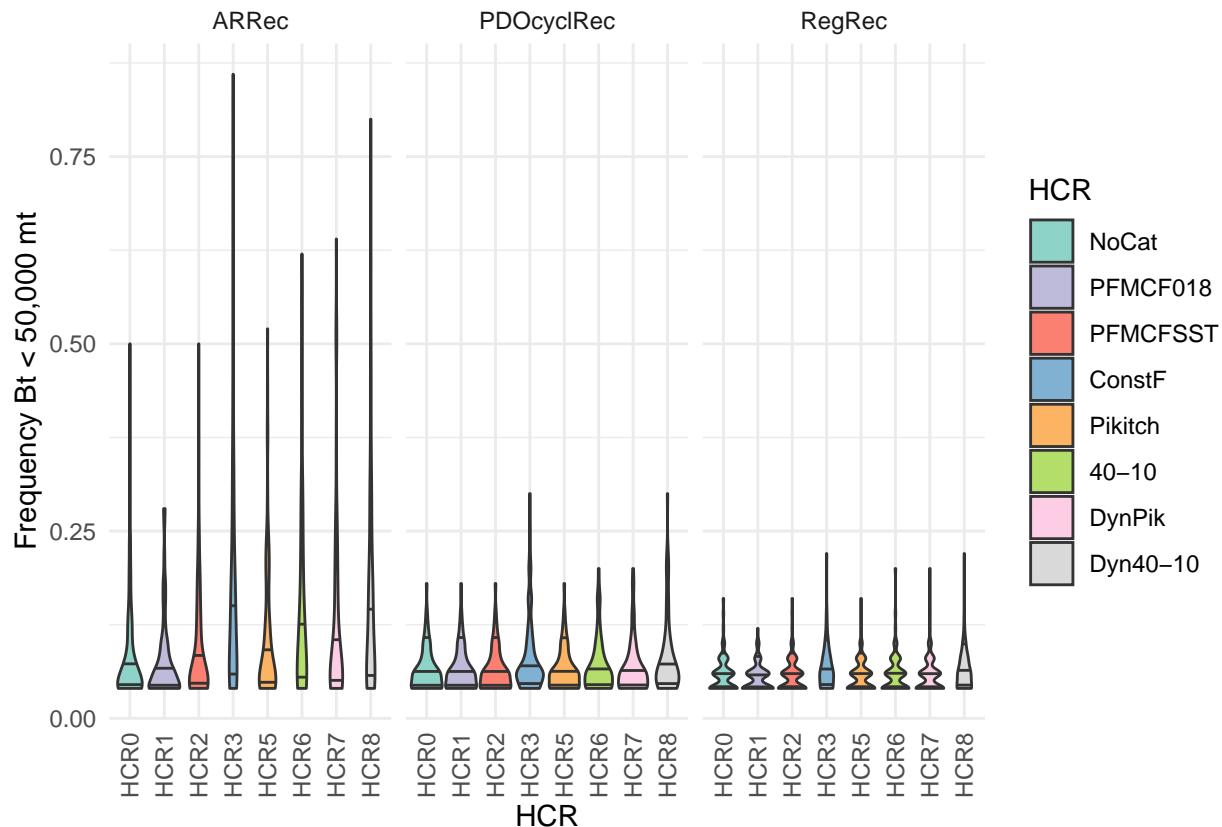
```



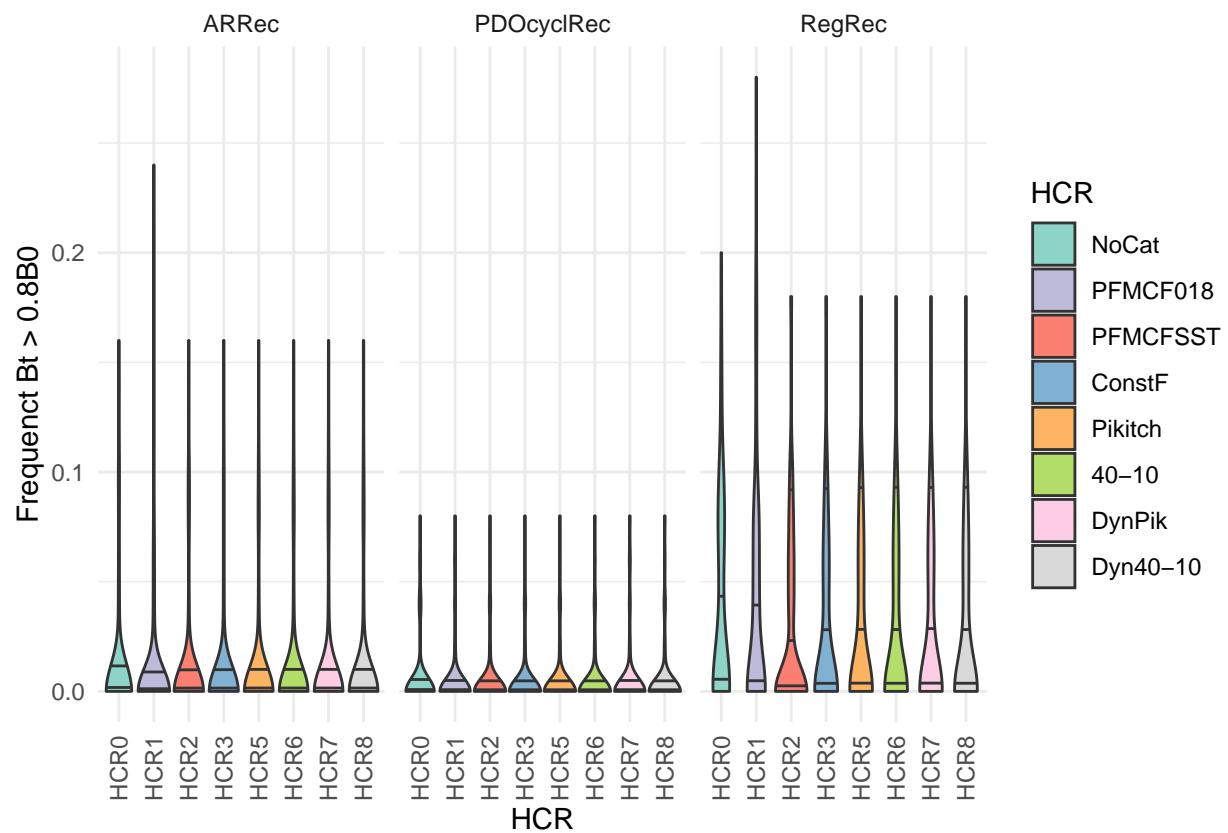
Fishery

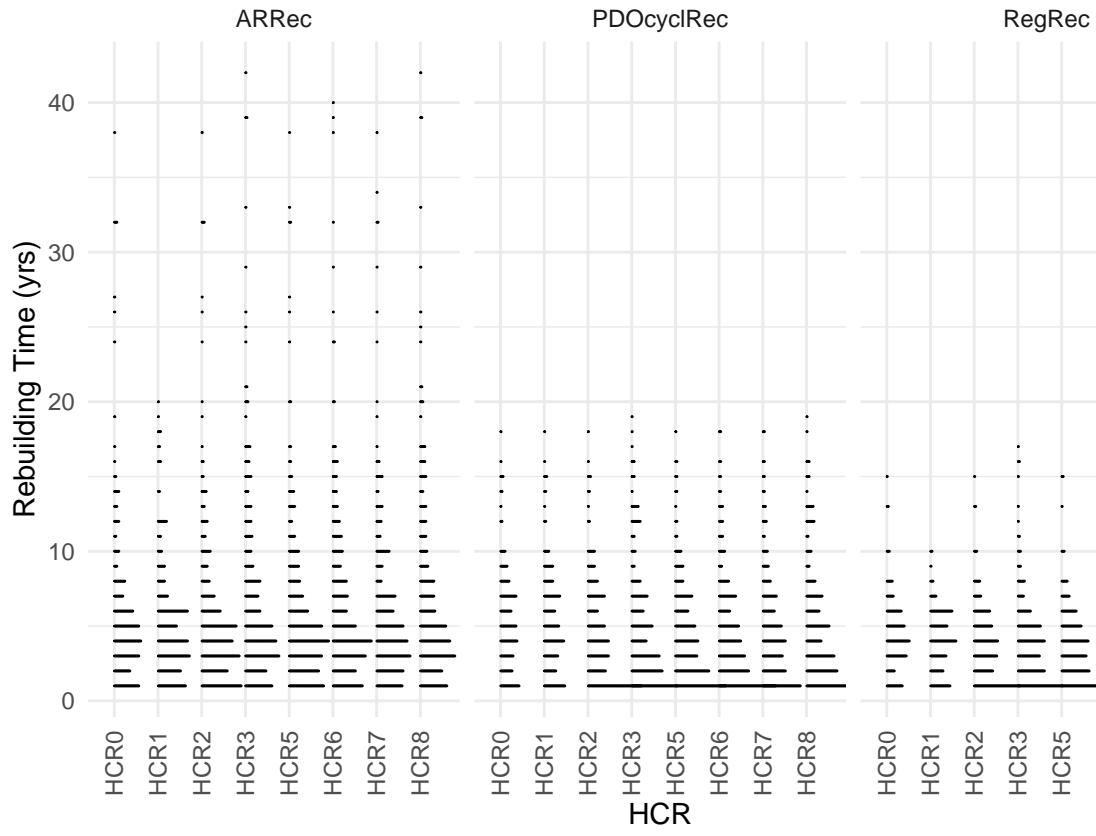






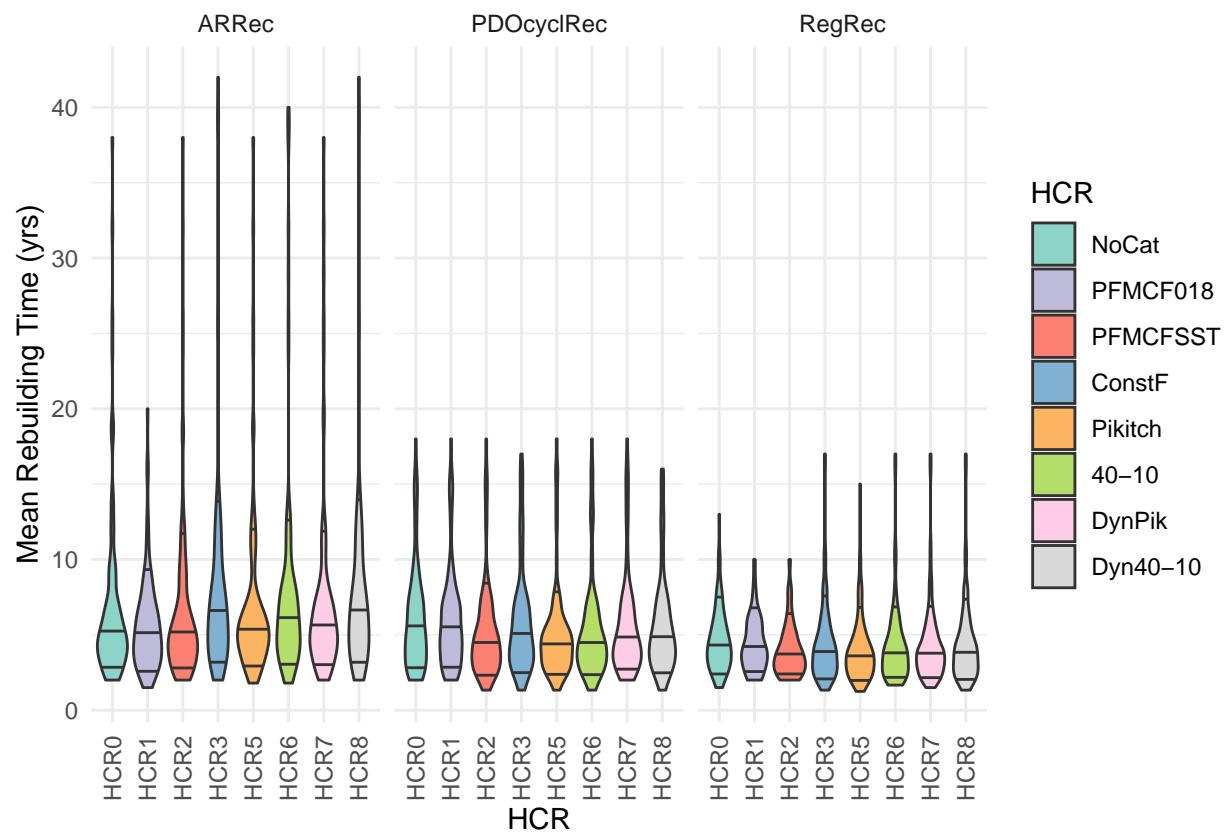
```
## Warning in regularize.values(x,
## y, ties, missing(ties), na.rm =
## na.rm): collapsing to unique 'x'
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```

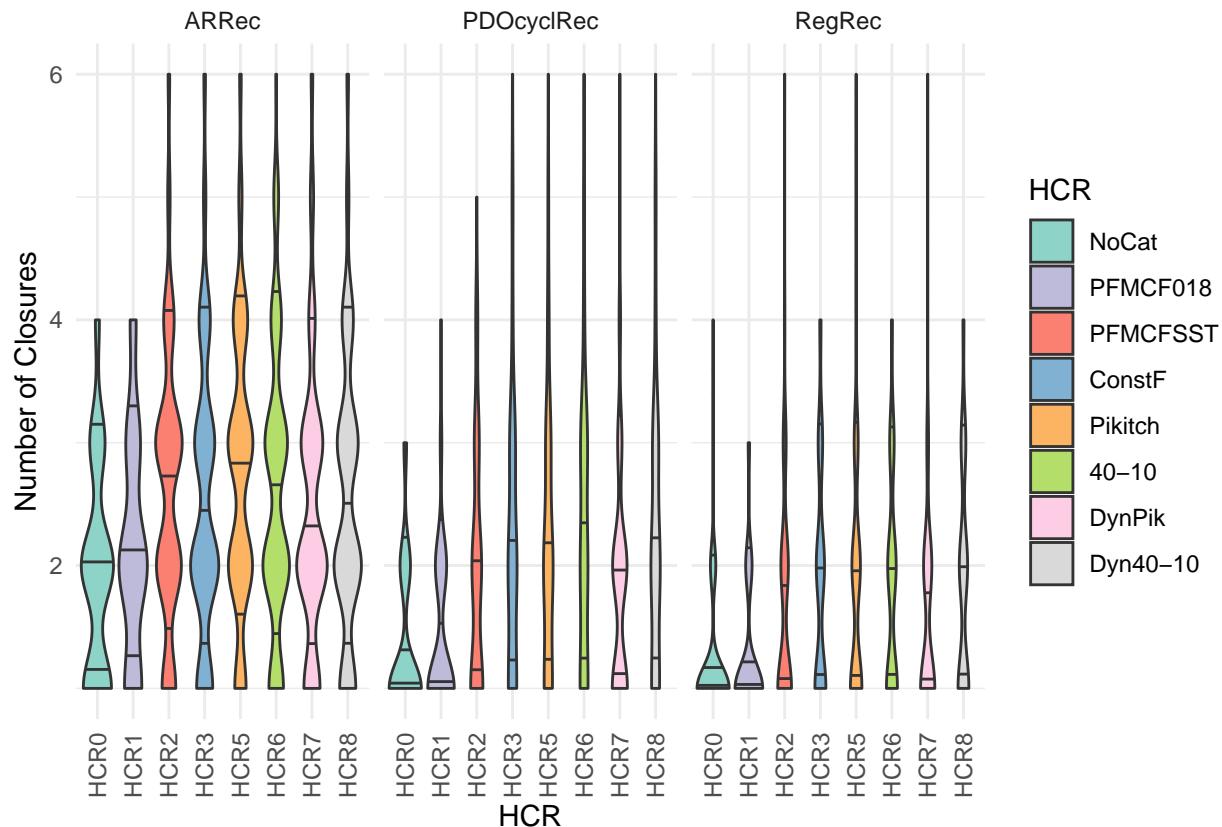




Investigate rebuilding lengths

```
## 'summarise()' has grouped output
## by 'model_run', 'iteration',
## 'scenario', 'HCR'. You can
## override using the '.groups'
## argument.
```

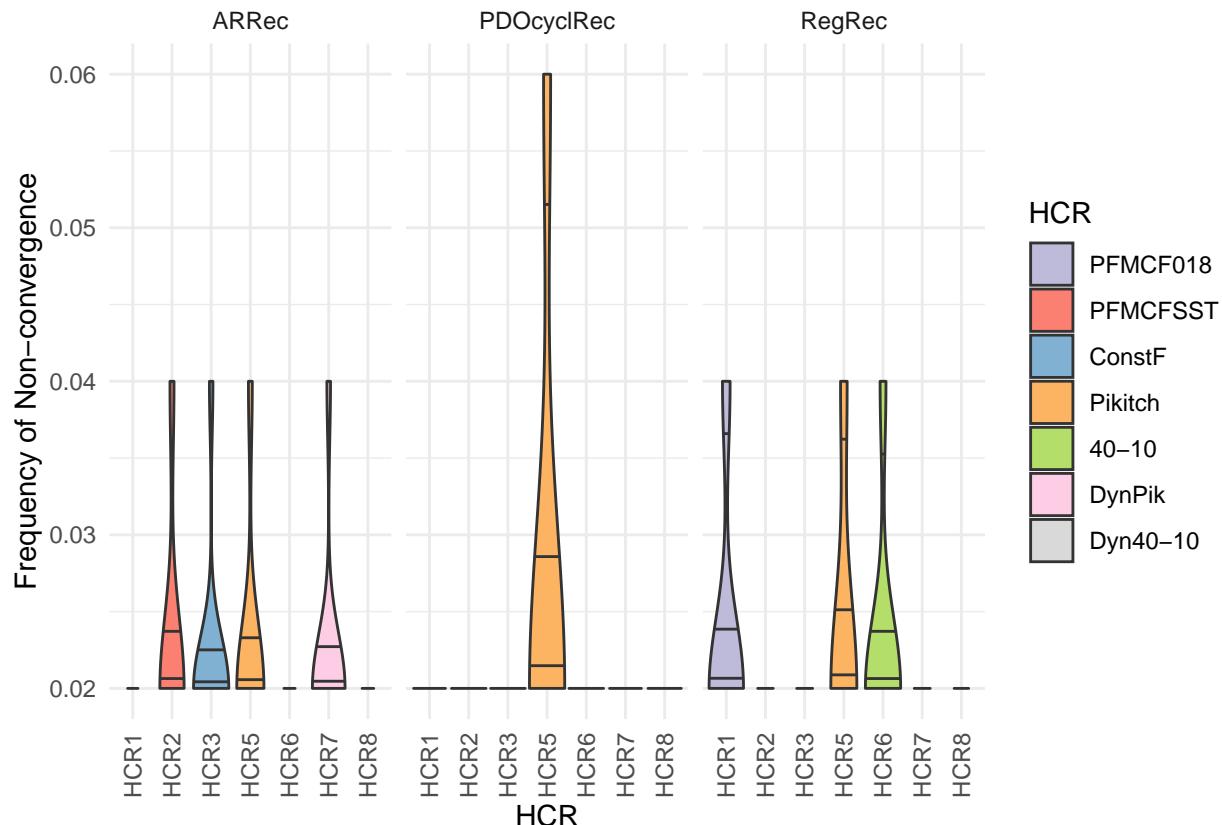




Assessment

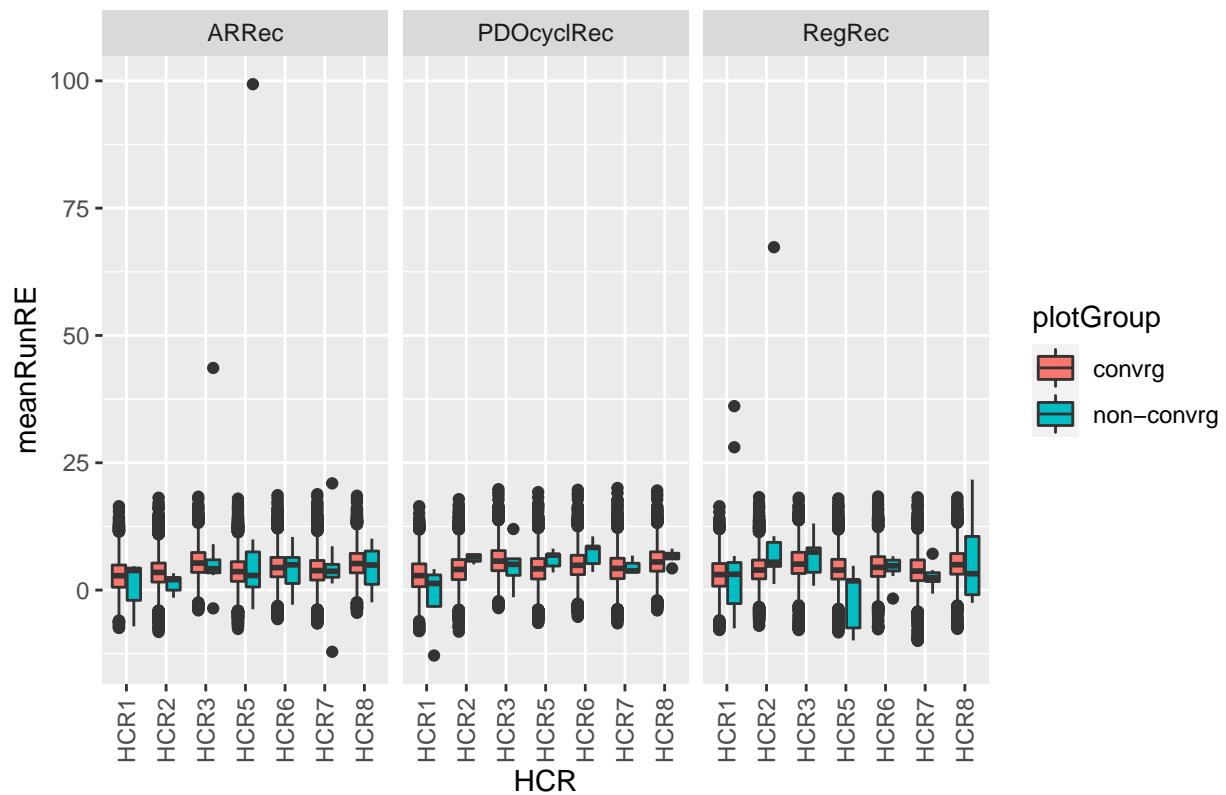
- Maximum non-convergence rate was 4% to 8% depending on the HCR
- For the overall assessment:
 - Cyclic PDO led to positive bias in annual biomass estimate
 - The SST scenario was expected to be unbiased for a given year
- Estimates of biomass in the final year of assessment were negatively biased
 - Cyclic PDO recruitment scenario was least biased
 - SST recruitment scenario was most biased

```
## Warning: Removed 1950 rows containing
##   non-finite values
##   (stat_ydensity).
```

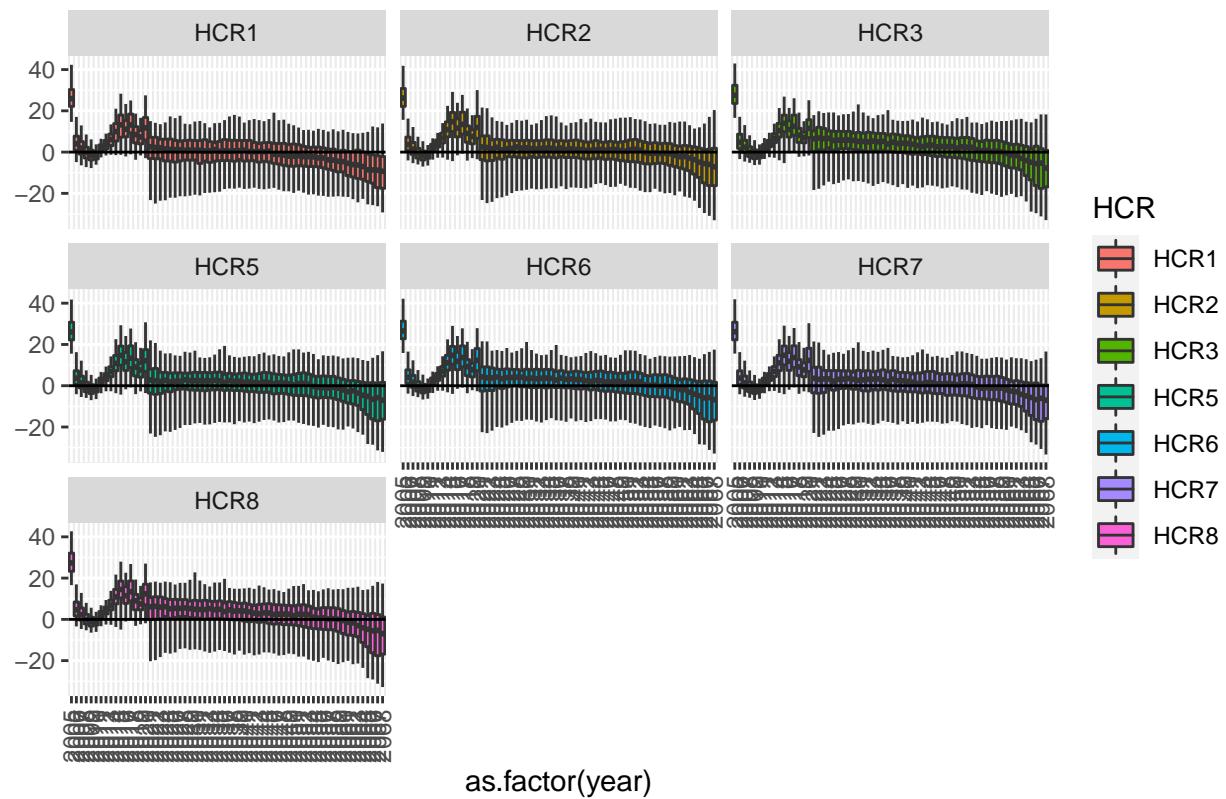


```
## `summarise()` has grouped output
## by 'model_run.x', 'iteration',
## 'scenario', 'HCR', 'recScen'. You
## can override using the '.groups'
## argument.
## `summarise()` has grouped output
## by 'year', 'scenario', 'HCR',
## 'recScen'. You can override using
## the '.groups' argument.
```

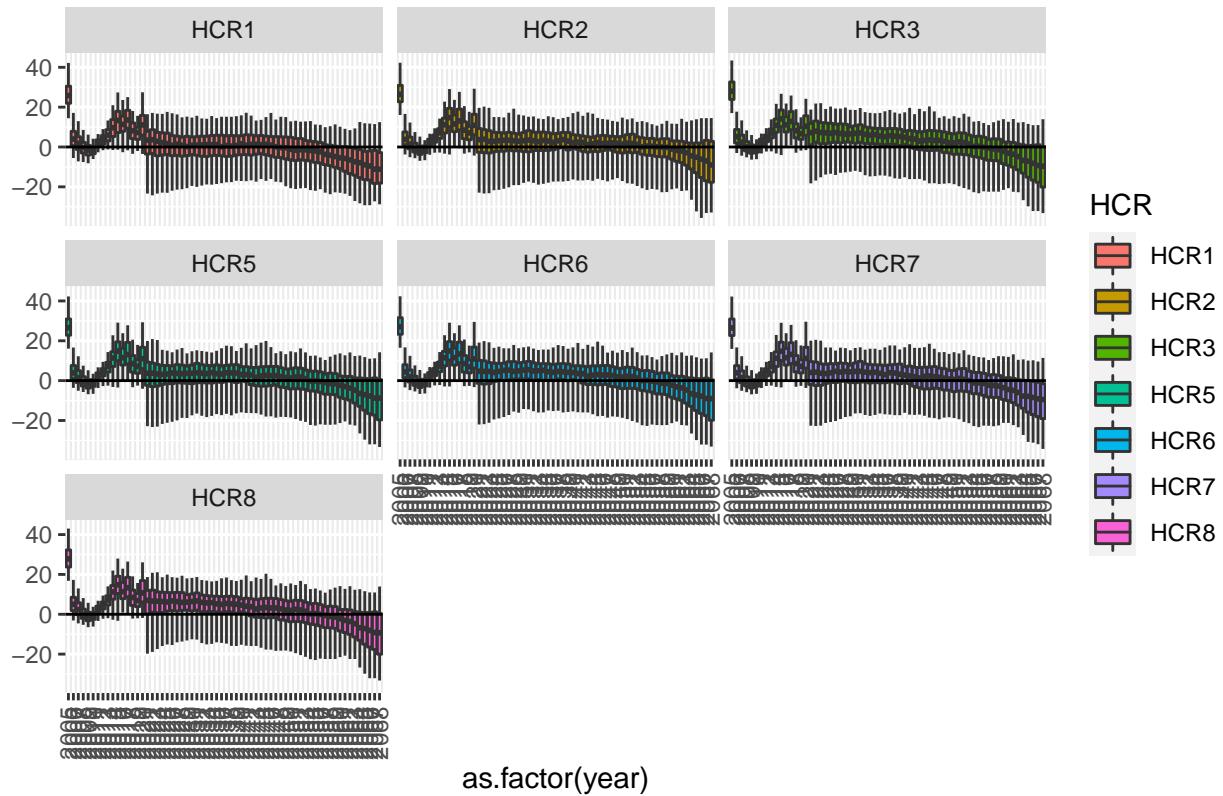
Mean Annual Relative Error of Assessment



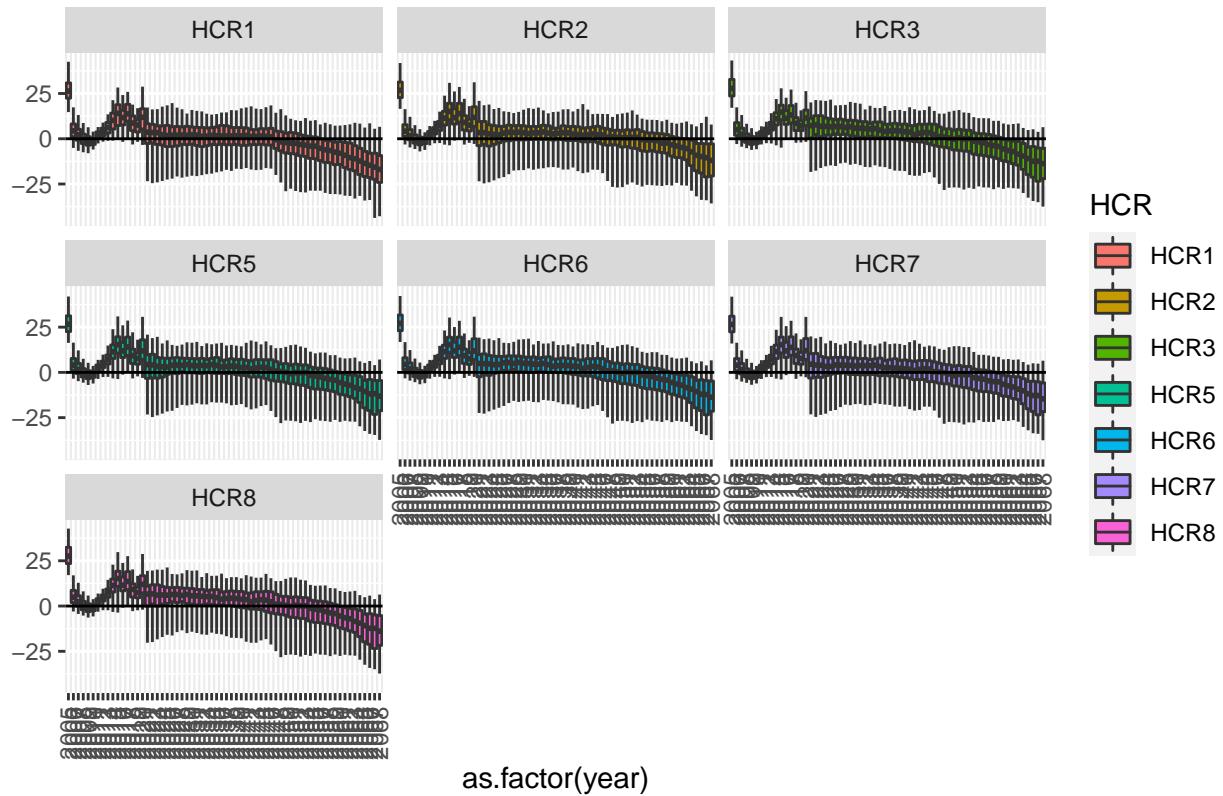
Median Annual Relative Error of Assessment, ARRec



Median Annual Relative Error of Assessment, PDOcyclRec

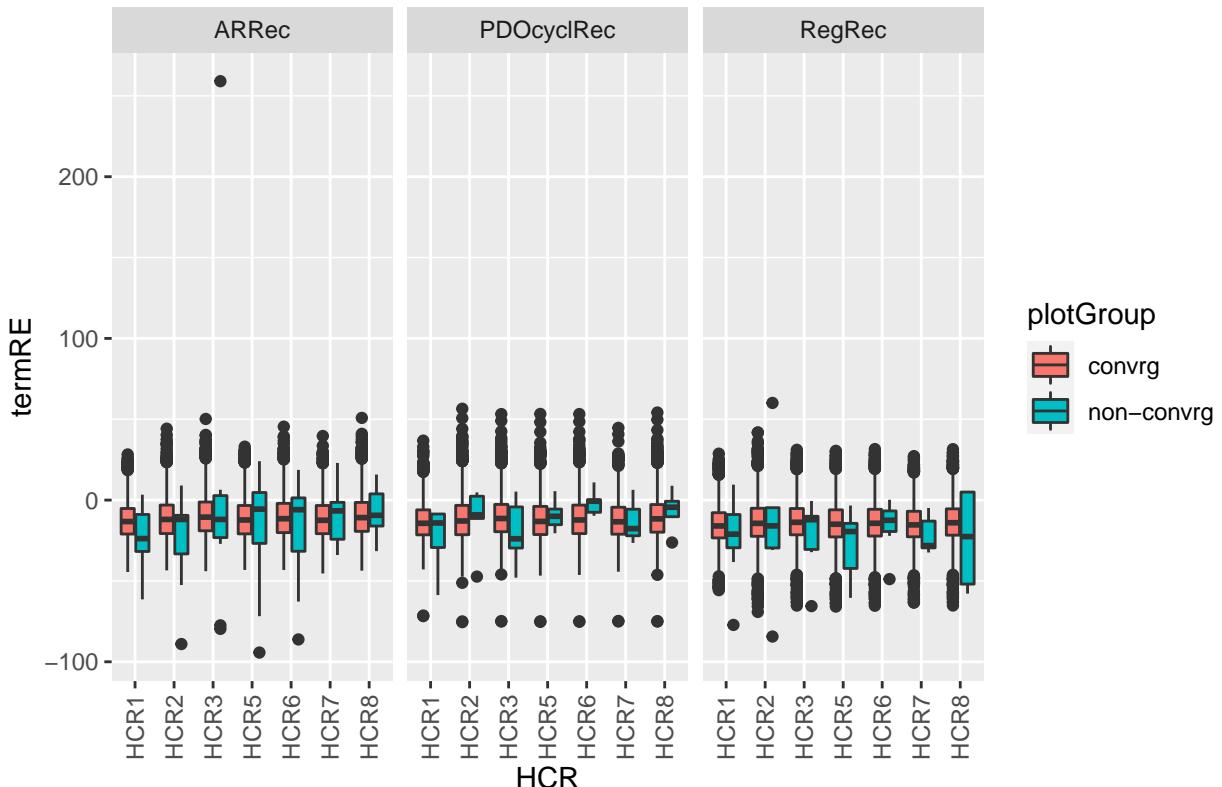


Median Annual Relative Error of Assessment, RegRec



```
## `summarise()` has grouped output
## by 'model_run.x', 'iteration',
## 'scenario', 'HCR', 'recScen'. You
## can override using the '.groups'
## argument.
```

Mean Terminal Relative Error of Assessment



```

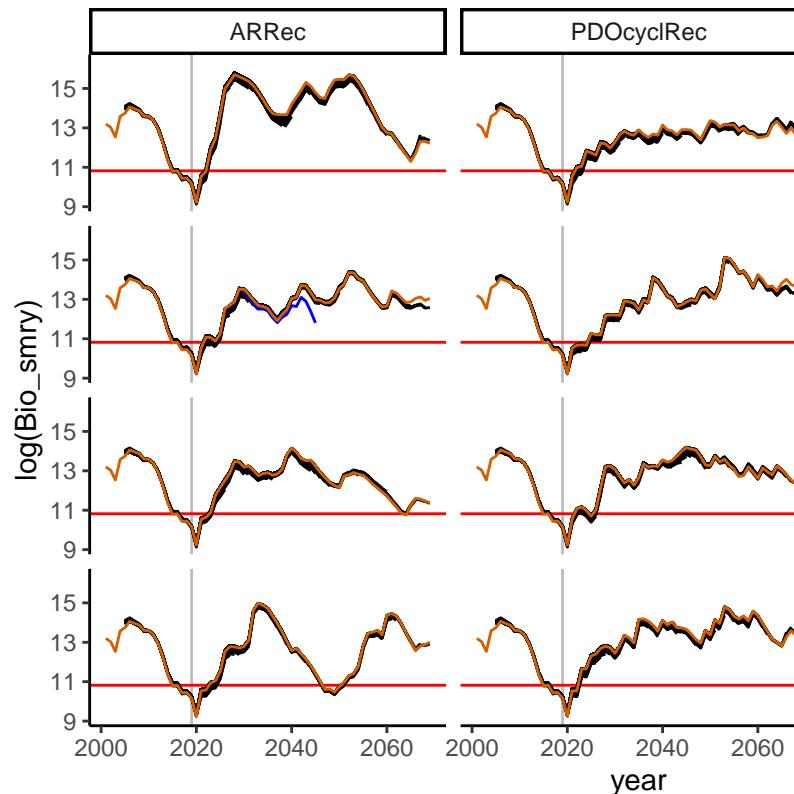
## `summarise()` has grouped output
## by `scenario`, `HCR`, `recScen`.
## You can override using the
## `.groups` argument.

## # A tibble: 42 x 6
## # Groups:   scenario, HCR, recScen
## #   [21]
##     scenario HCR   recScen plotGroup
##     <chr>    <chr>  <chr>    <chr>
## 1 constGr~ HCR1   ARRec    convrg
## 2 constGr~ HCR1   ARRec    non-conv~
## 3 constGr~ HCR2   ARRec    convrg
## 4 constGr~ HCR2   ARRec    non-conv~
## 5 constGr~ HCR3   ARRec    convrg
## 6 constGr~ HCR3   ARRec    non-conv~
## 7 constGr~ HCR5   ARRec    convrg
## 8 constGr~ HCR5   ARRec    non-conv~
## 9 constGr~ HCR6   ARRec    convrg
## 10 constGr~ HCR6  ARRec    non-conv~
## # ... with 32 more rows, and 2
## #   more variables:
## #   termScenHCR_RE <dbl>,
## #   itN <int>

```

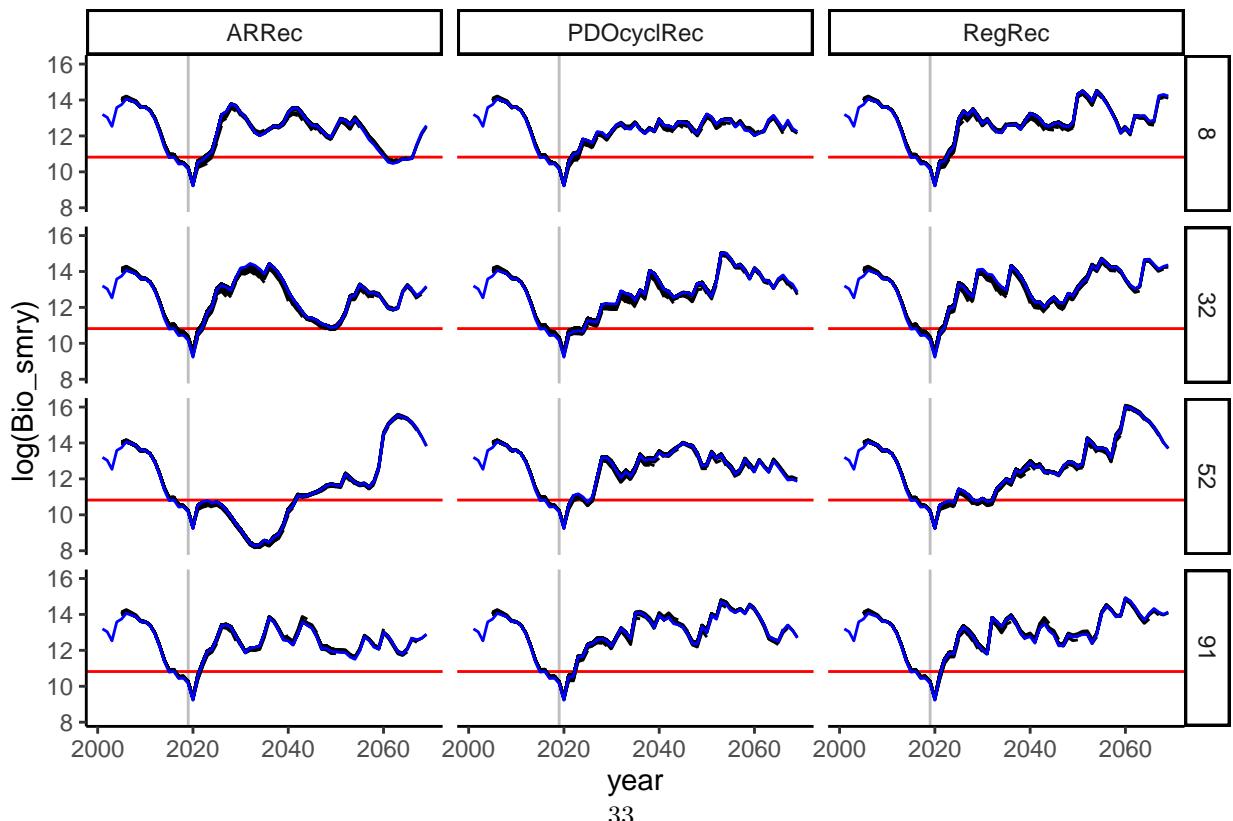
Error Progression

HCR1

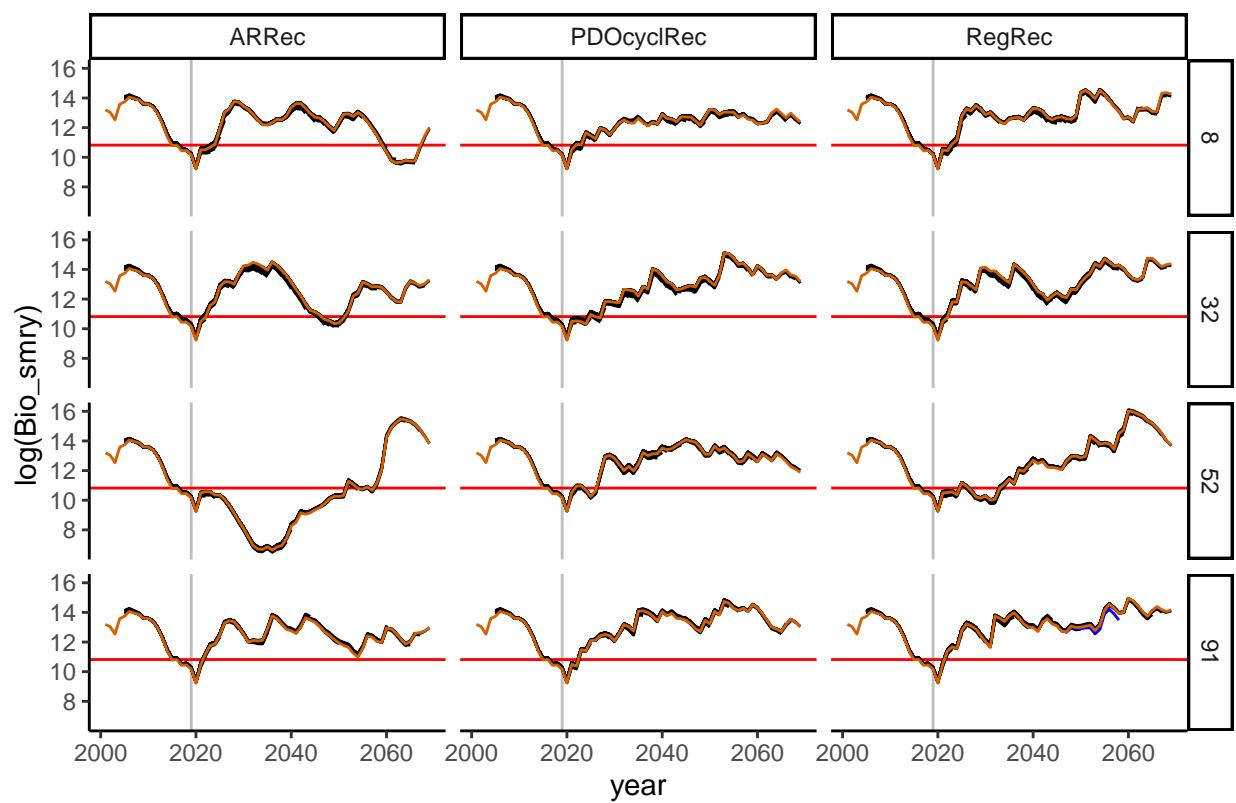


Plot some timeseries over estimation models for each run

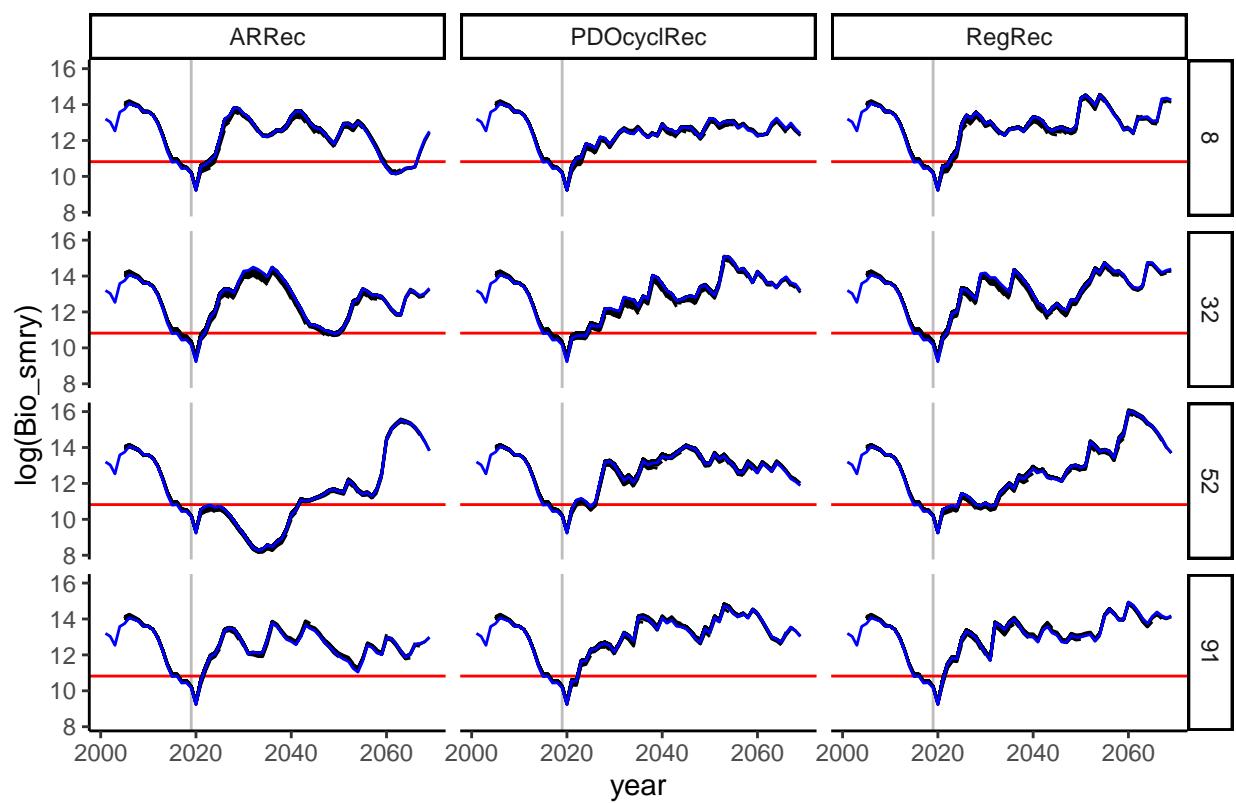
HCR2



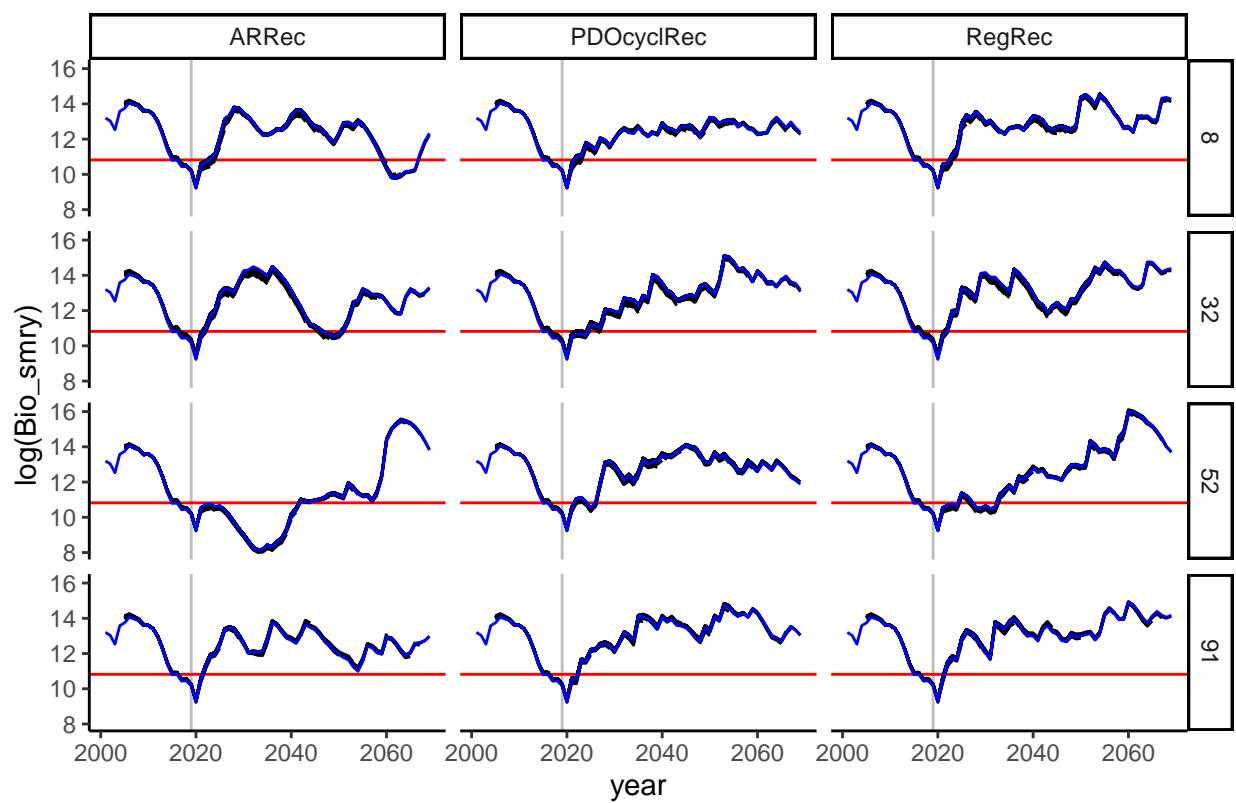
HCR3



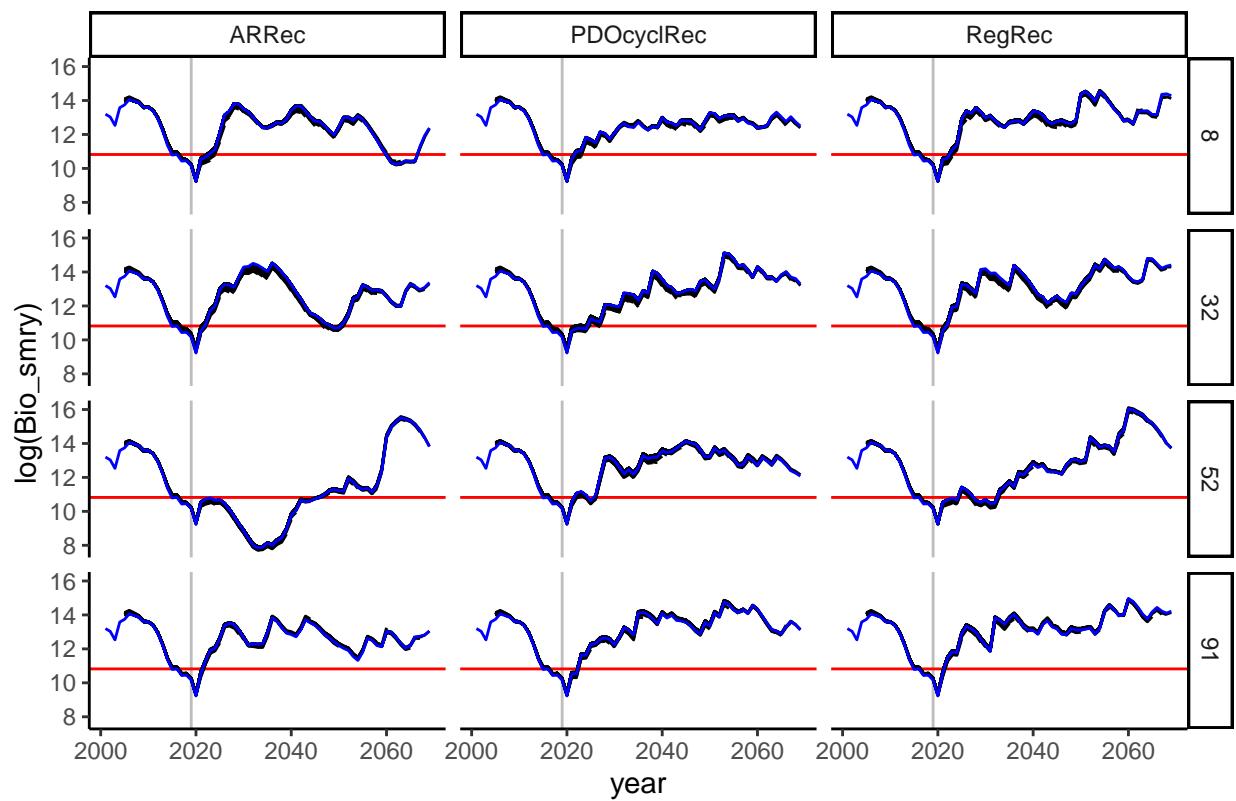
HCR5



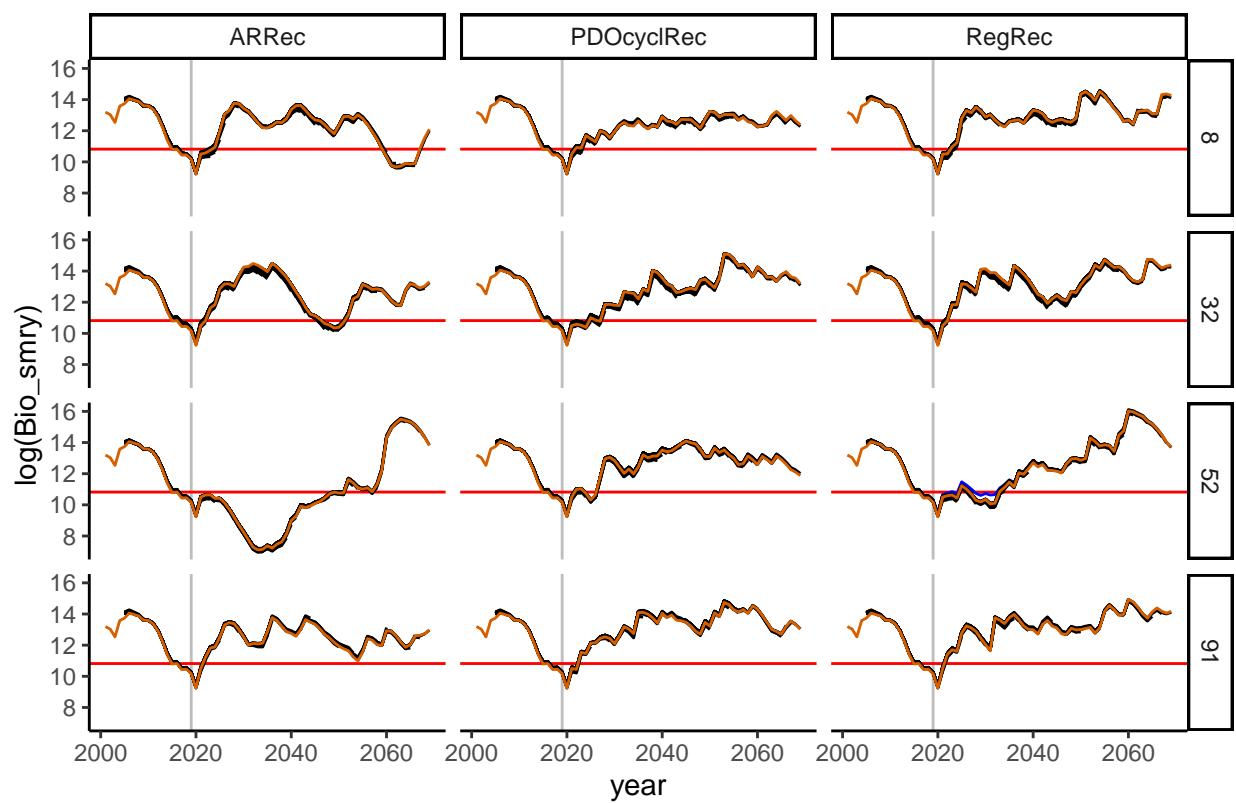
HCR6



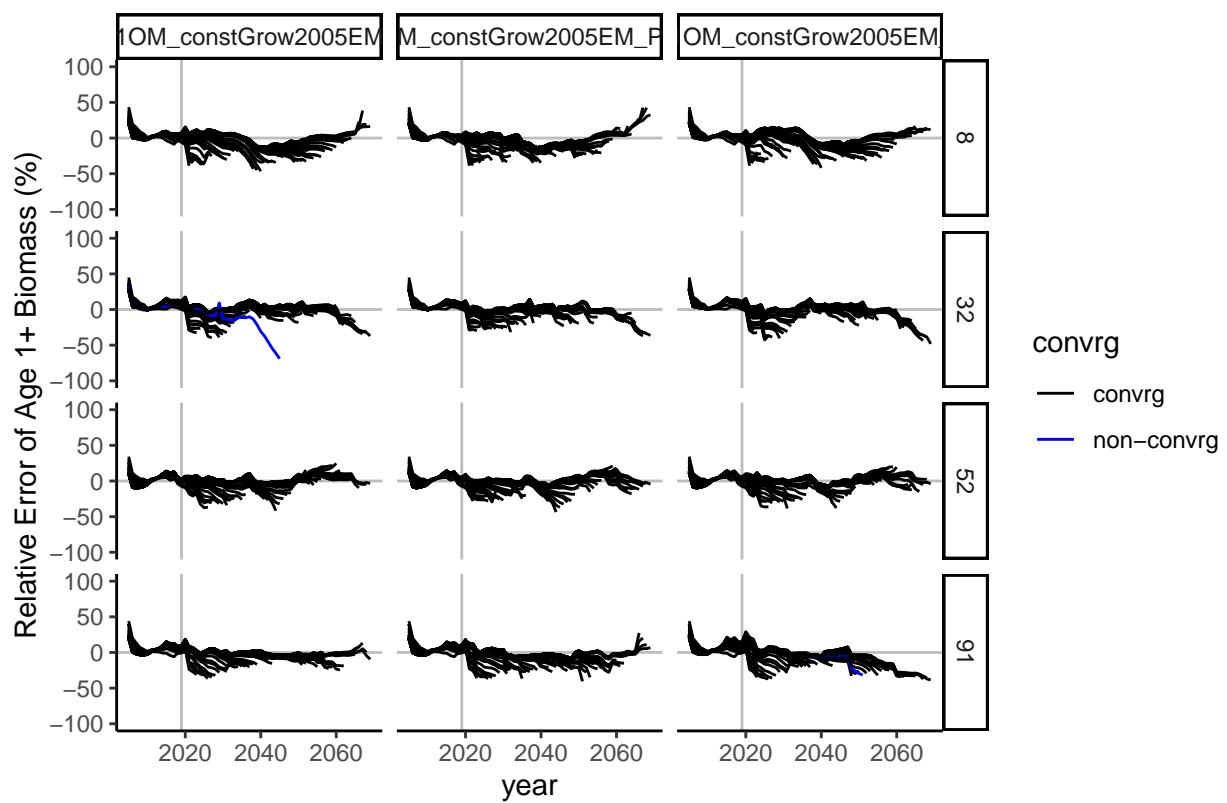
HCR7



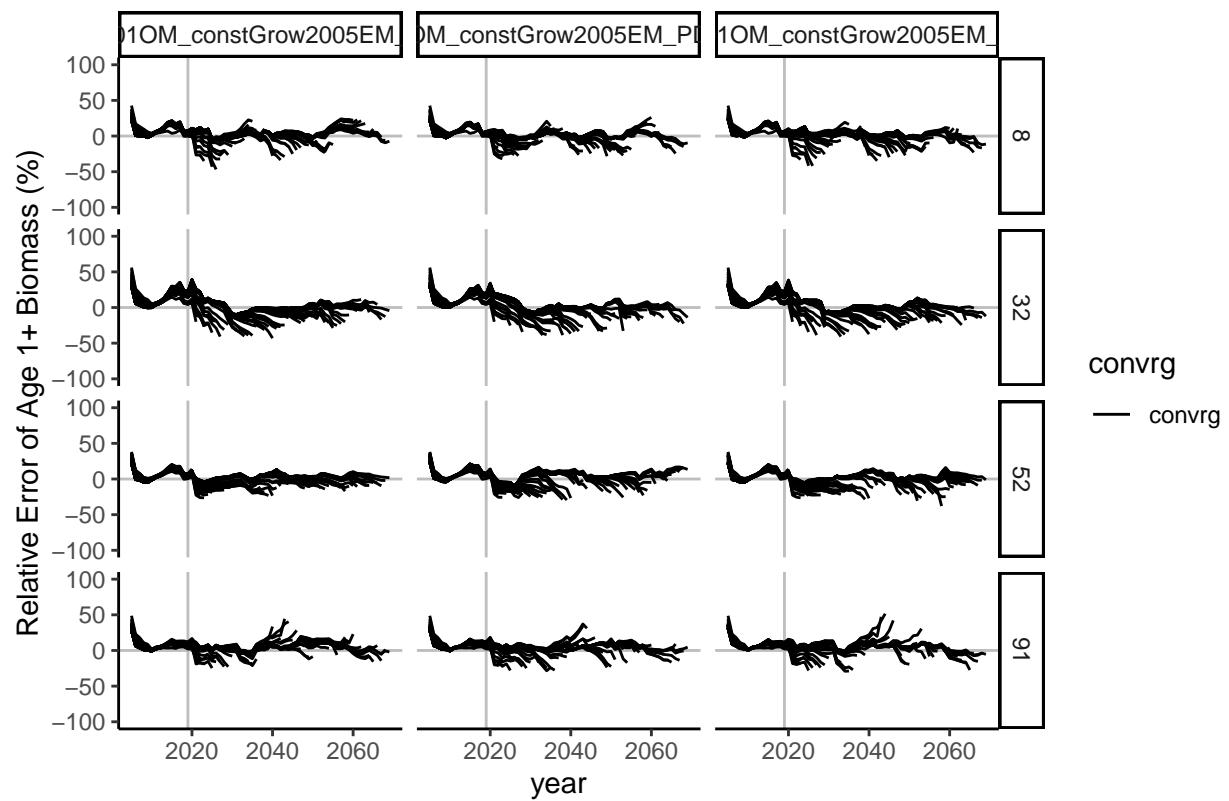
HCR8



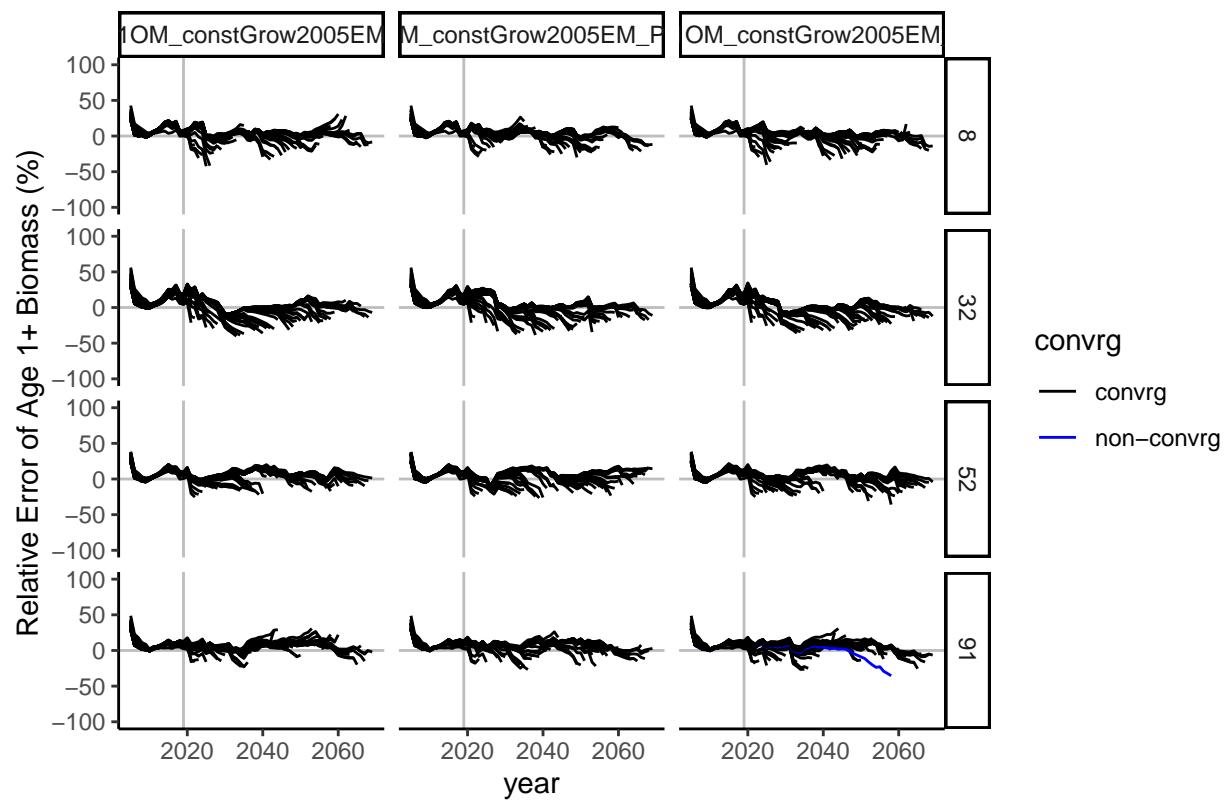
HCR1



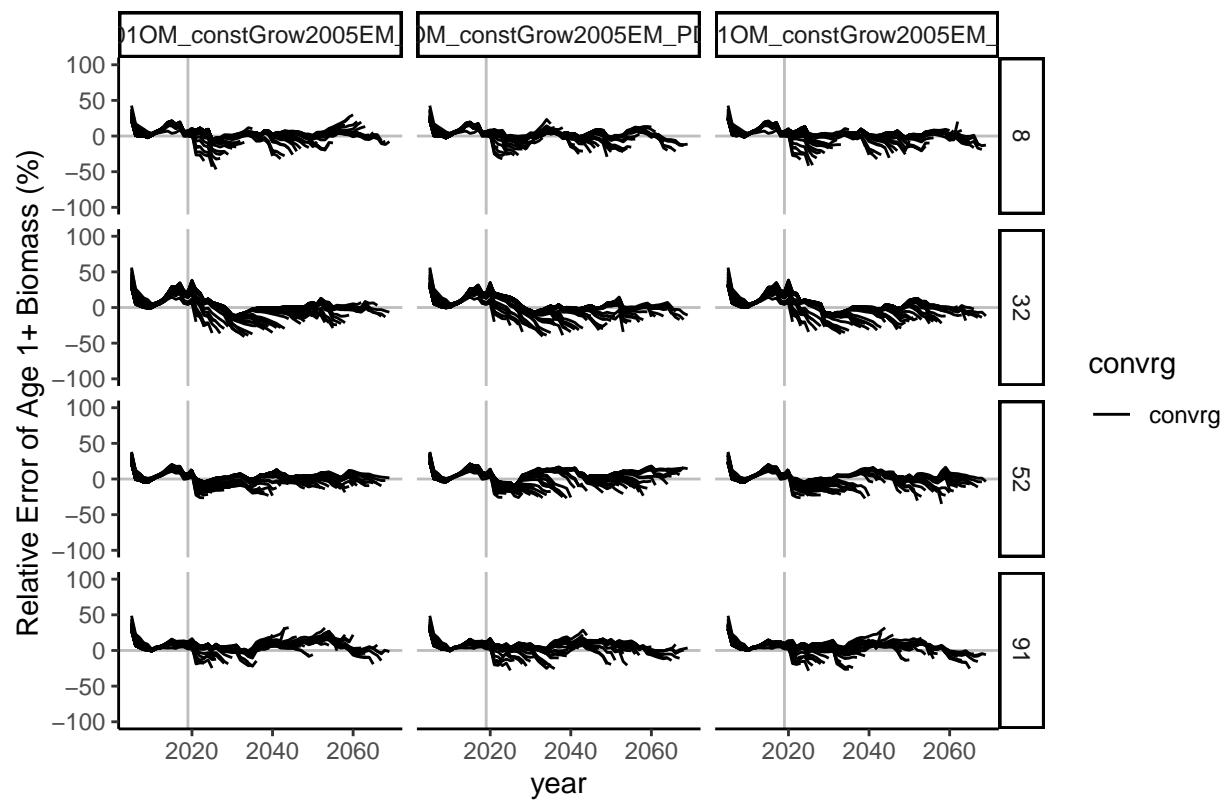
HCR2



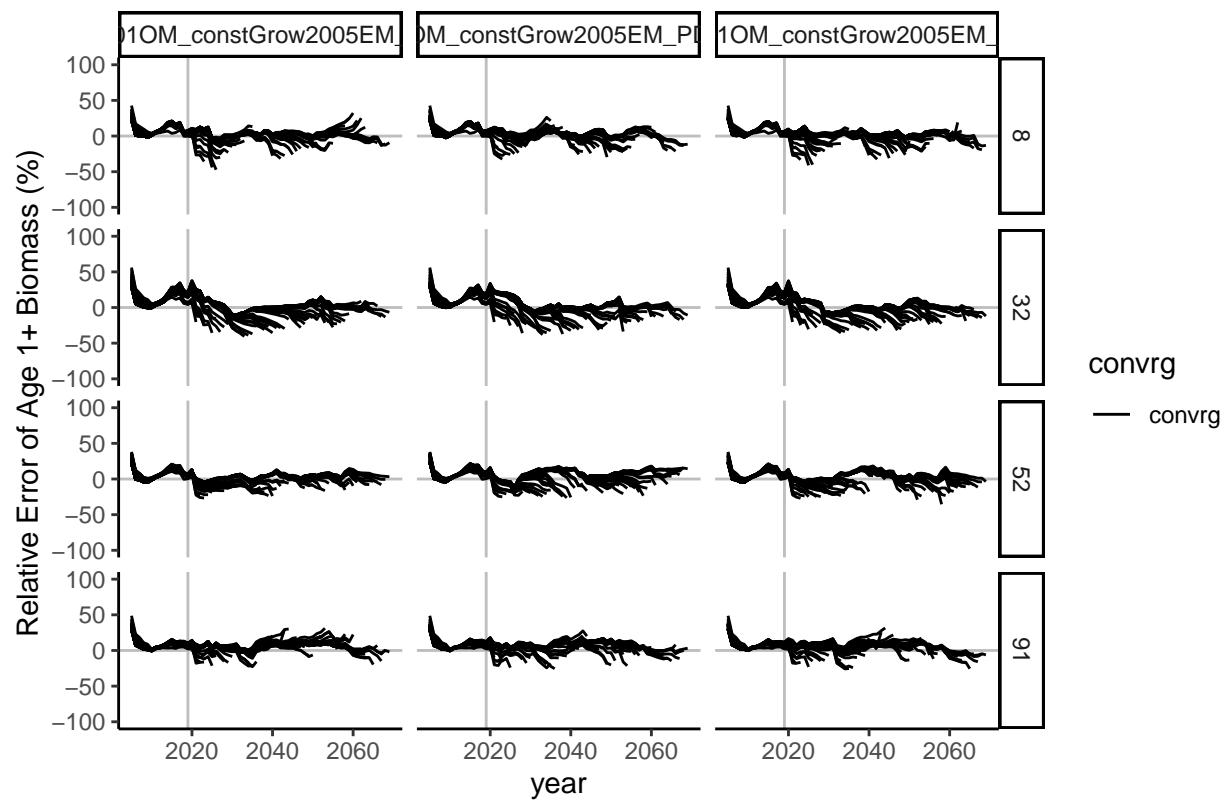
HCR3



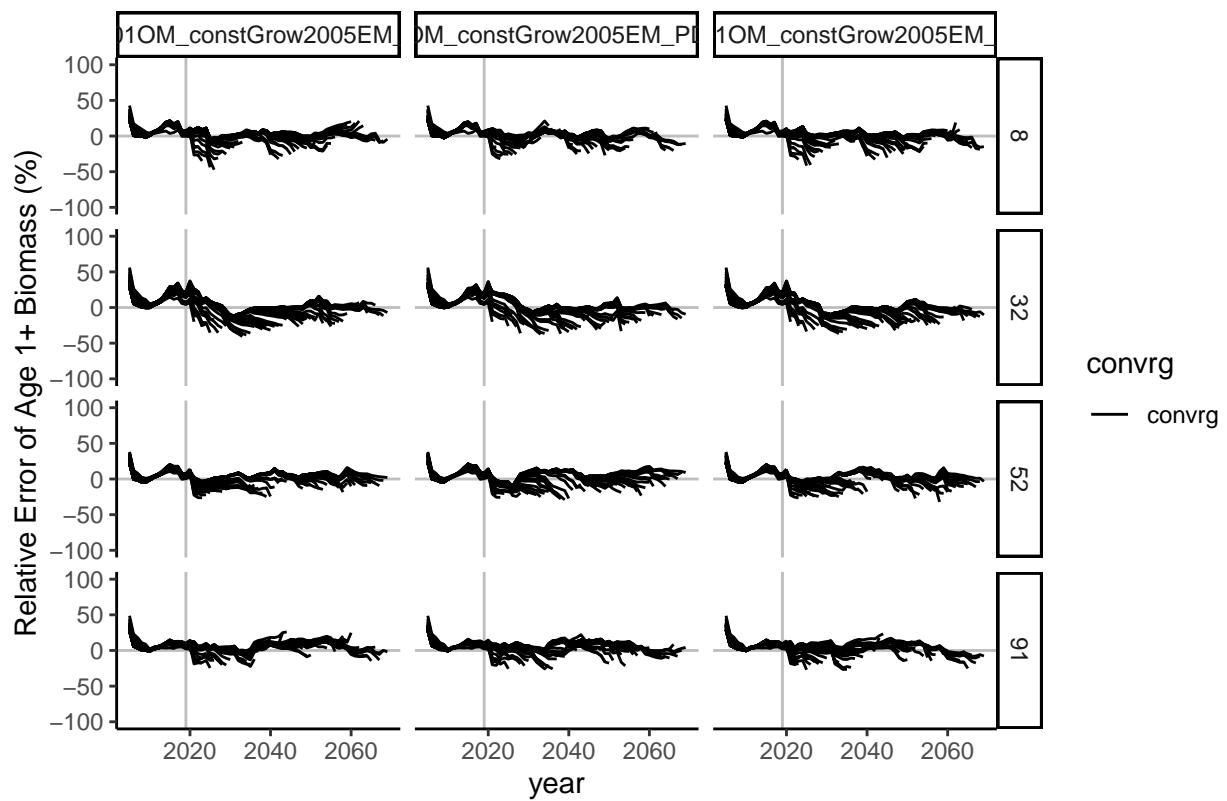
HCR5



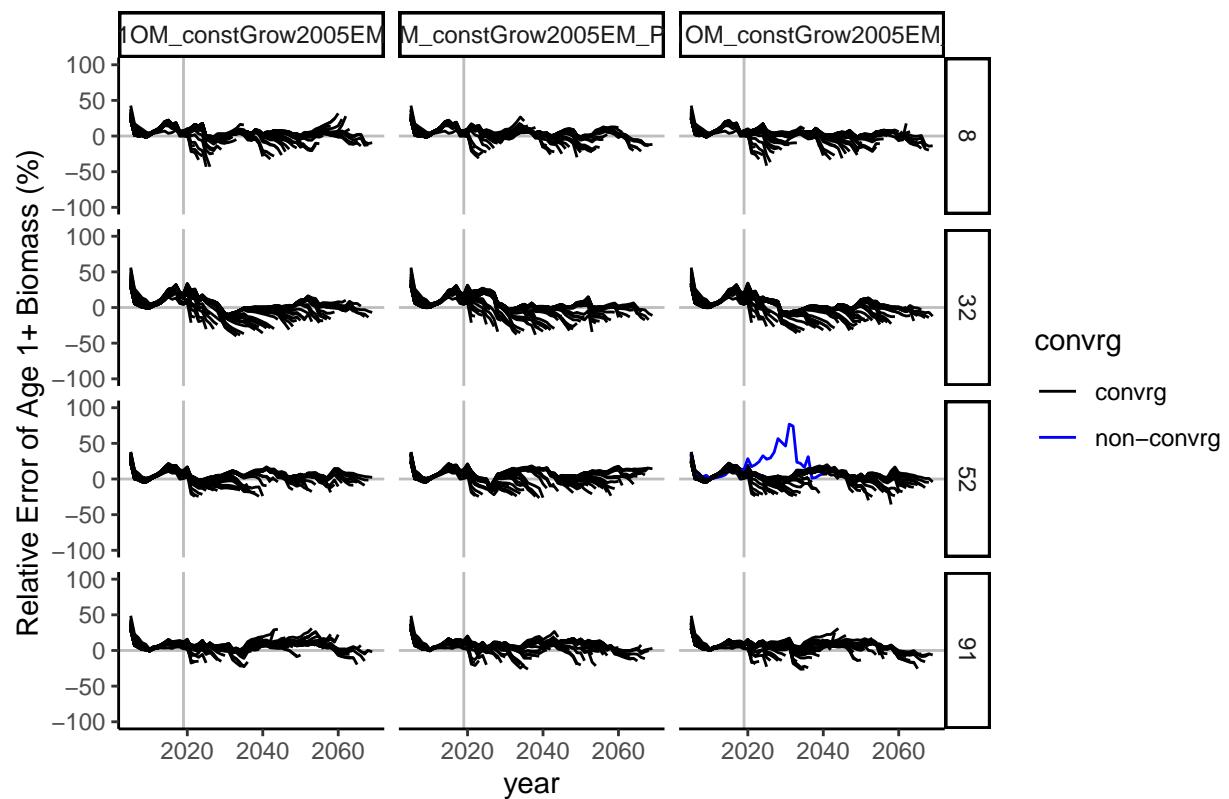
HCR6



HCR7



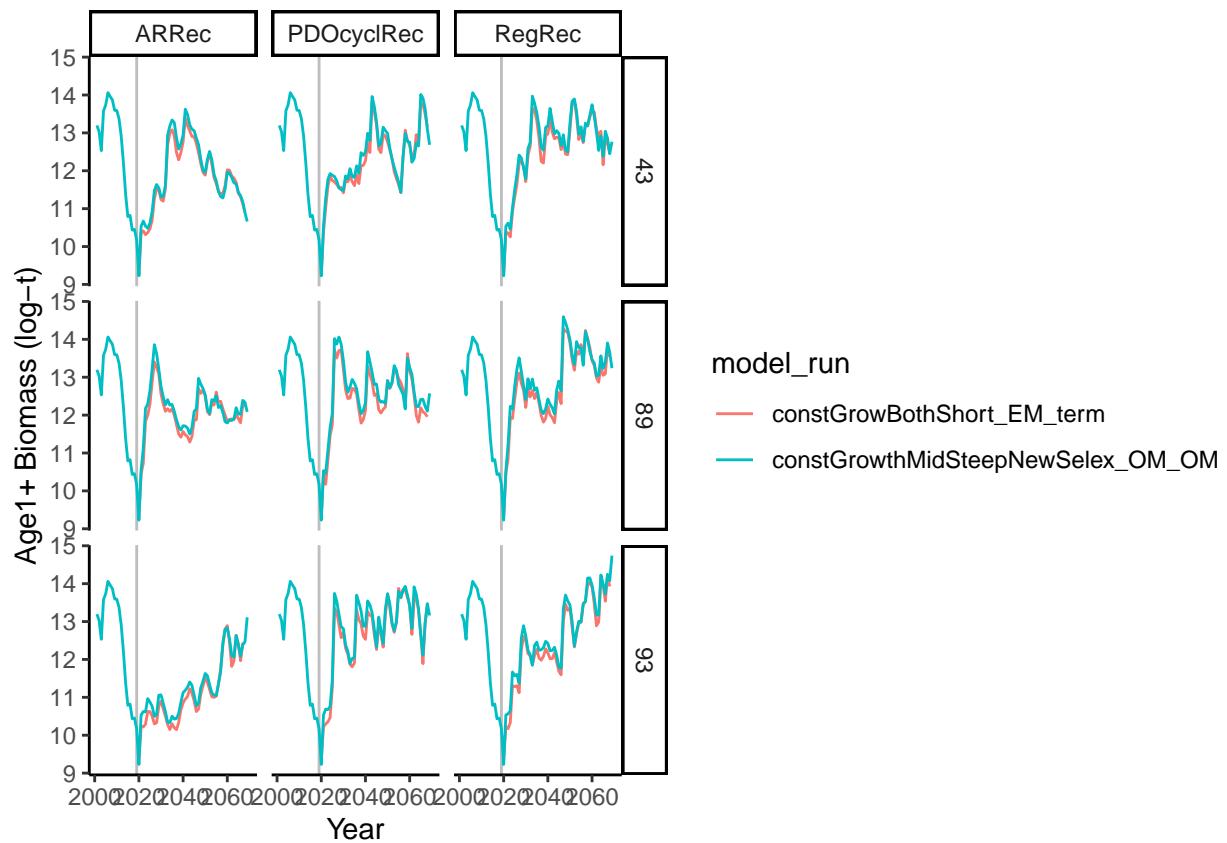
HCR8



Terminal Year Error

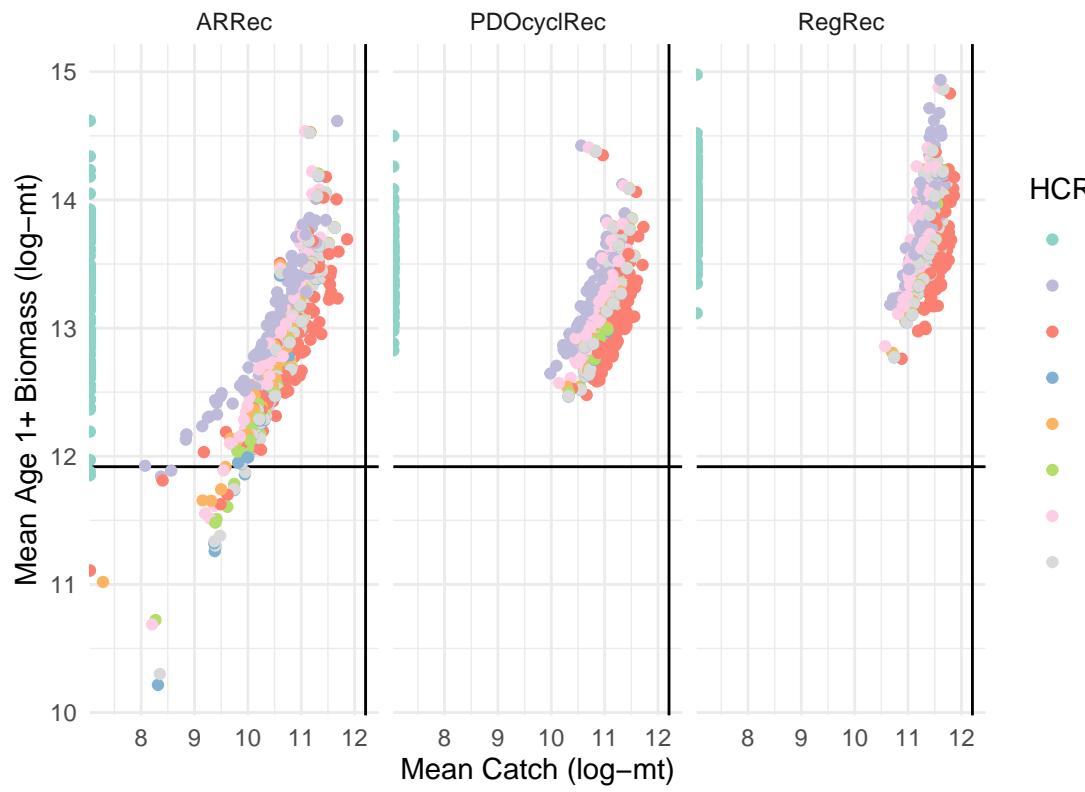
Error of final assessment year over projection

```
## Warning: Removed 3 row(s)
## containing missing values
## (geom_path).
```



Tradeoffs

Mean Biomass x Mean Catch



Plot tradeoffs among metrics

```
## Warning: Removed 2400 rows containing  
## missing values (geom_point).
```

Annual Biomass x Annual Catch

