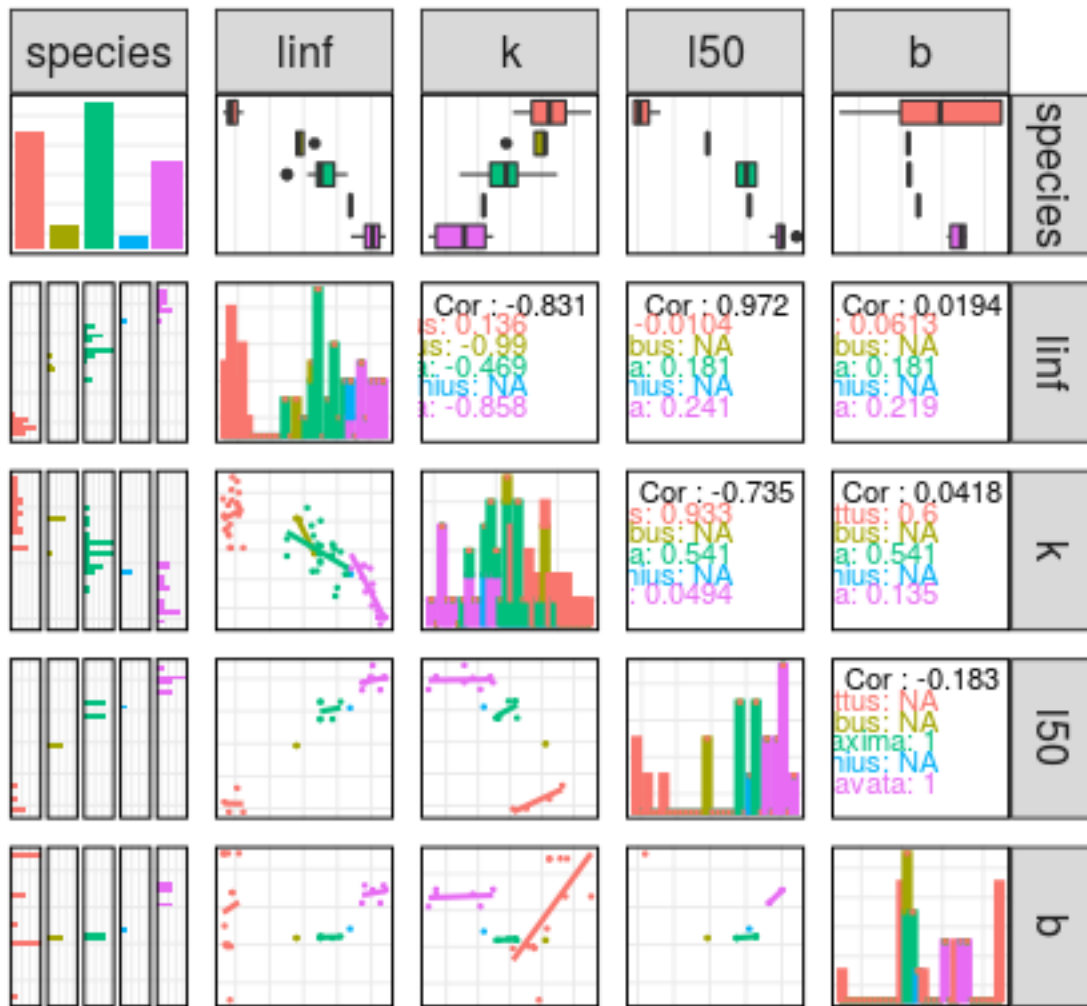


# Proxy $MSY$ Reference Points for data poor stocks

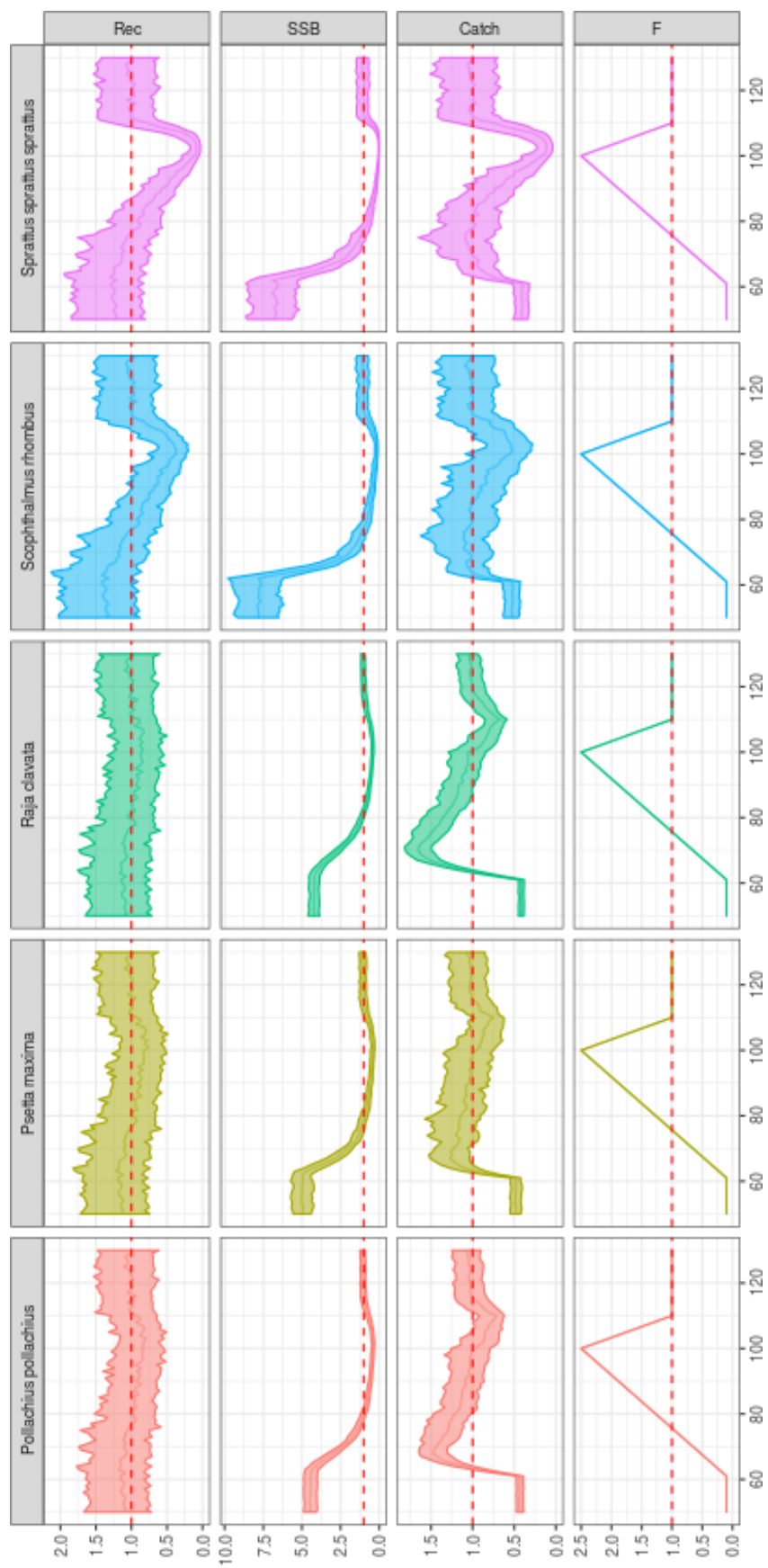
Power of length based indicators to detect overfishing.

*L Kell*

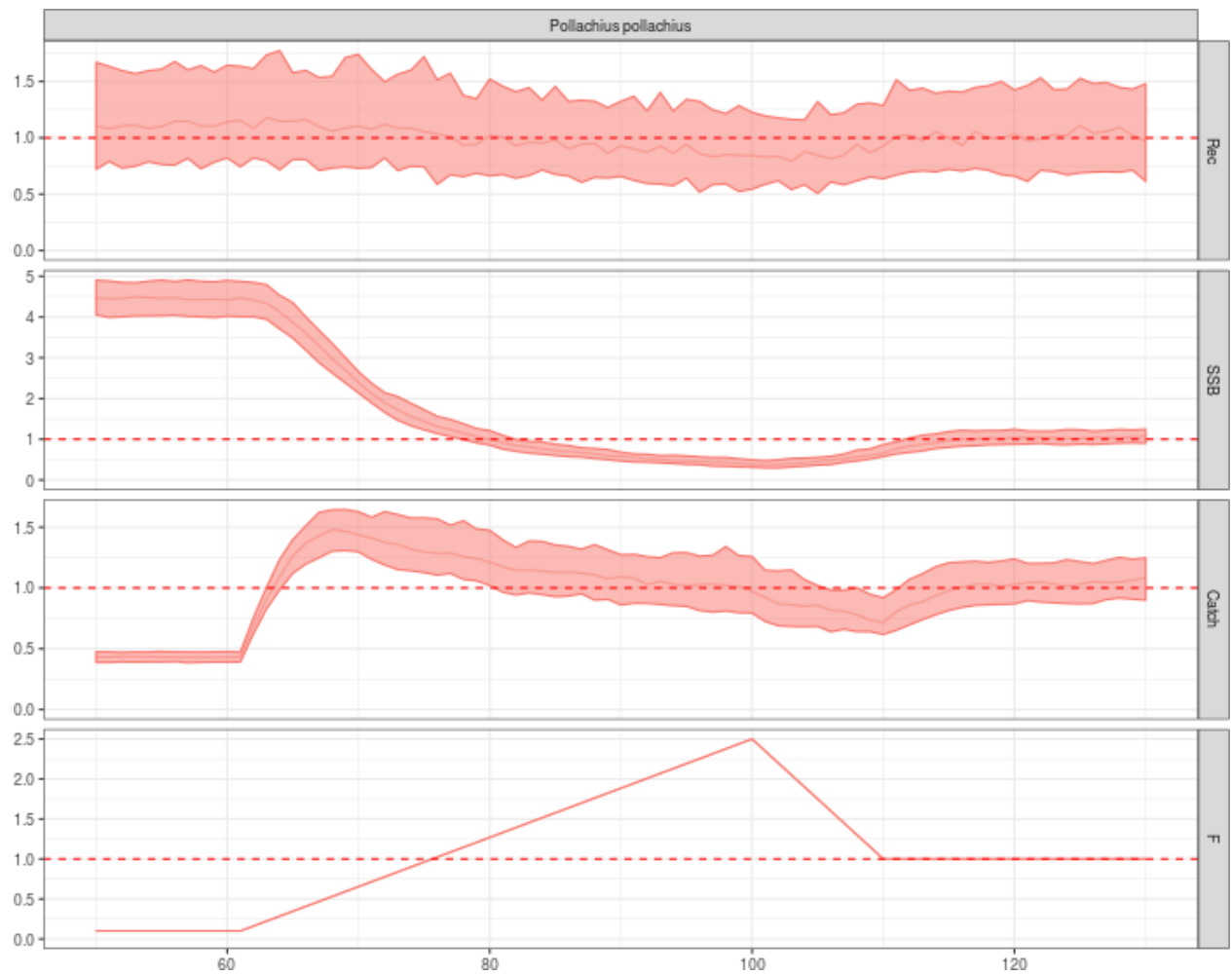
*13 October, 2019*



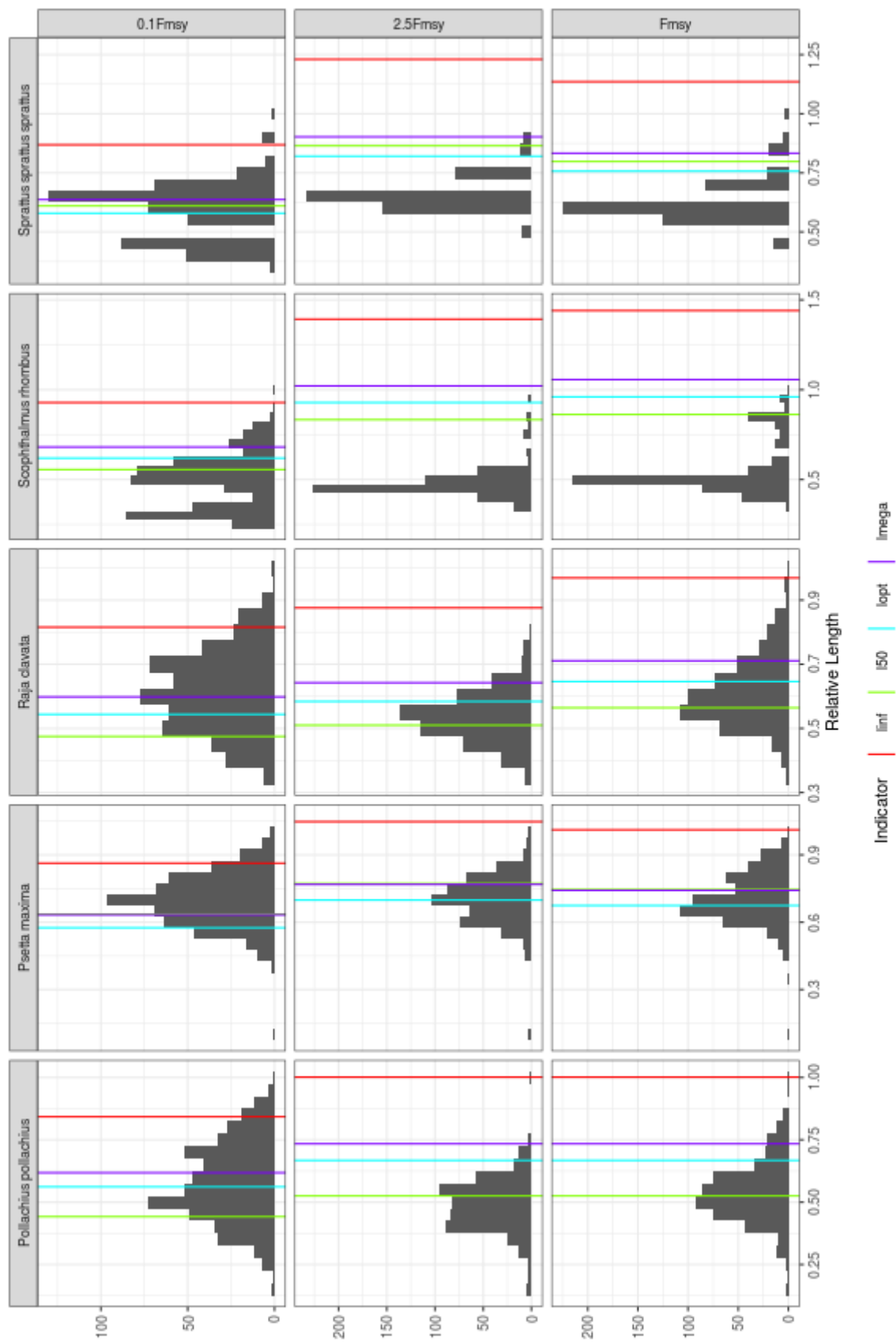
**Figure 1** Correlation between life history parameters.



**Figure 2** Time series relative to MSY benchmarks.



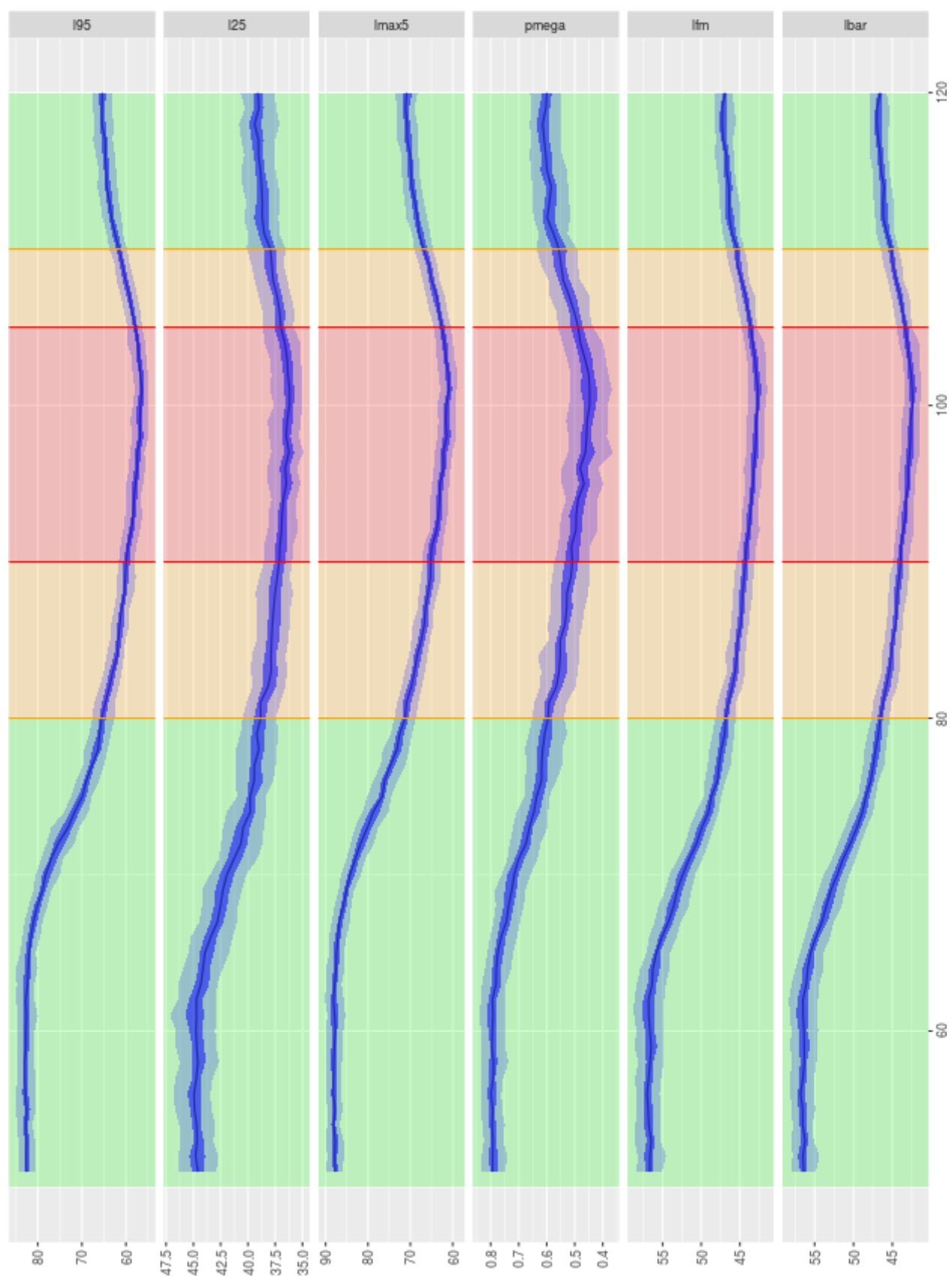
**Figure 3** Time series relative to MSY benchmarks.



**Figure 4.** Simulated length frequencies distributions with indicators.

## Pollack examples







**Figure 5.** Lfm time series of indicators compared to  $F : F_{MSY}$ , vertical lines indicate 1 (green), 1.5 (orange) and 2 (red) times  $F_{MSY}$ .

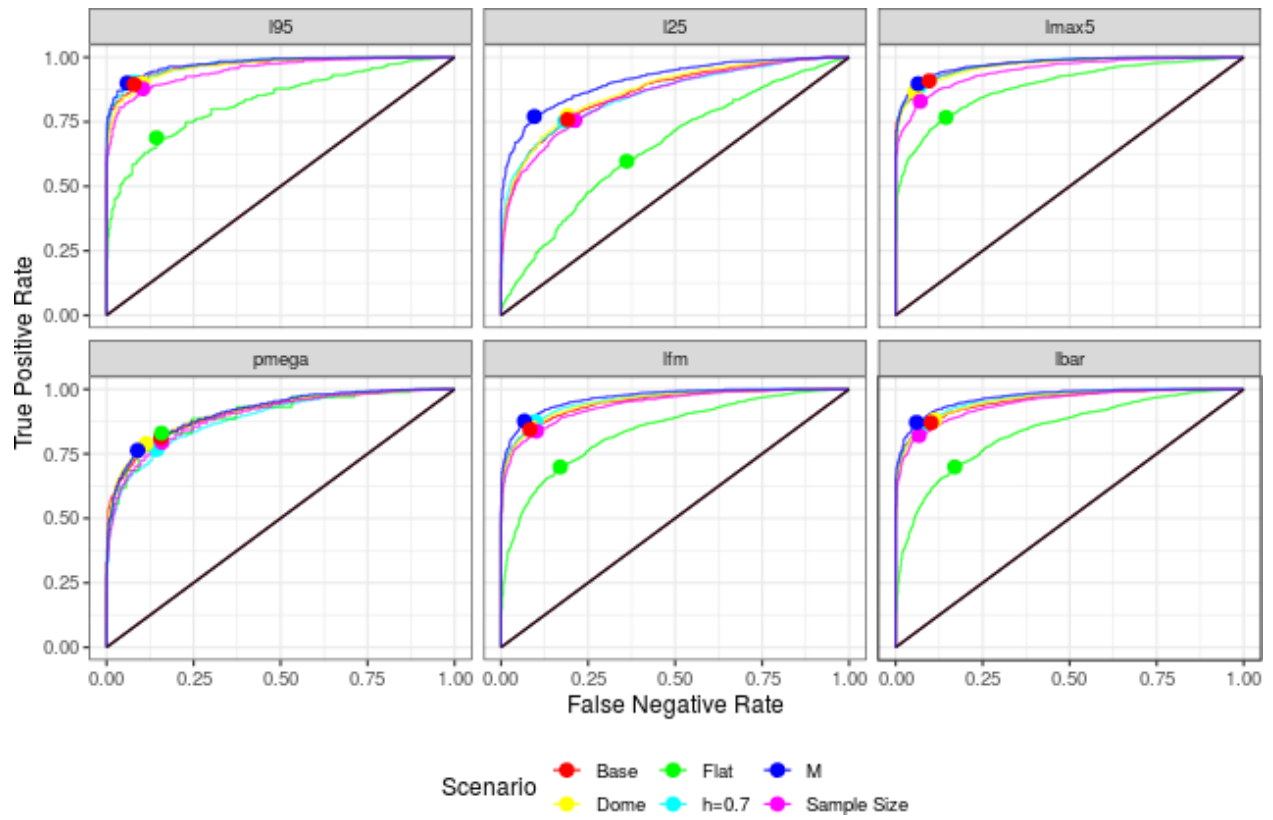
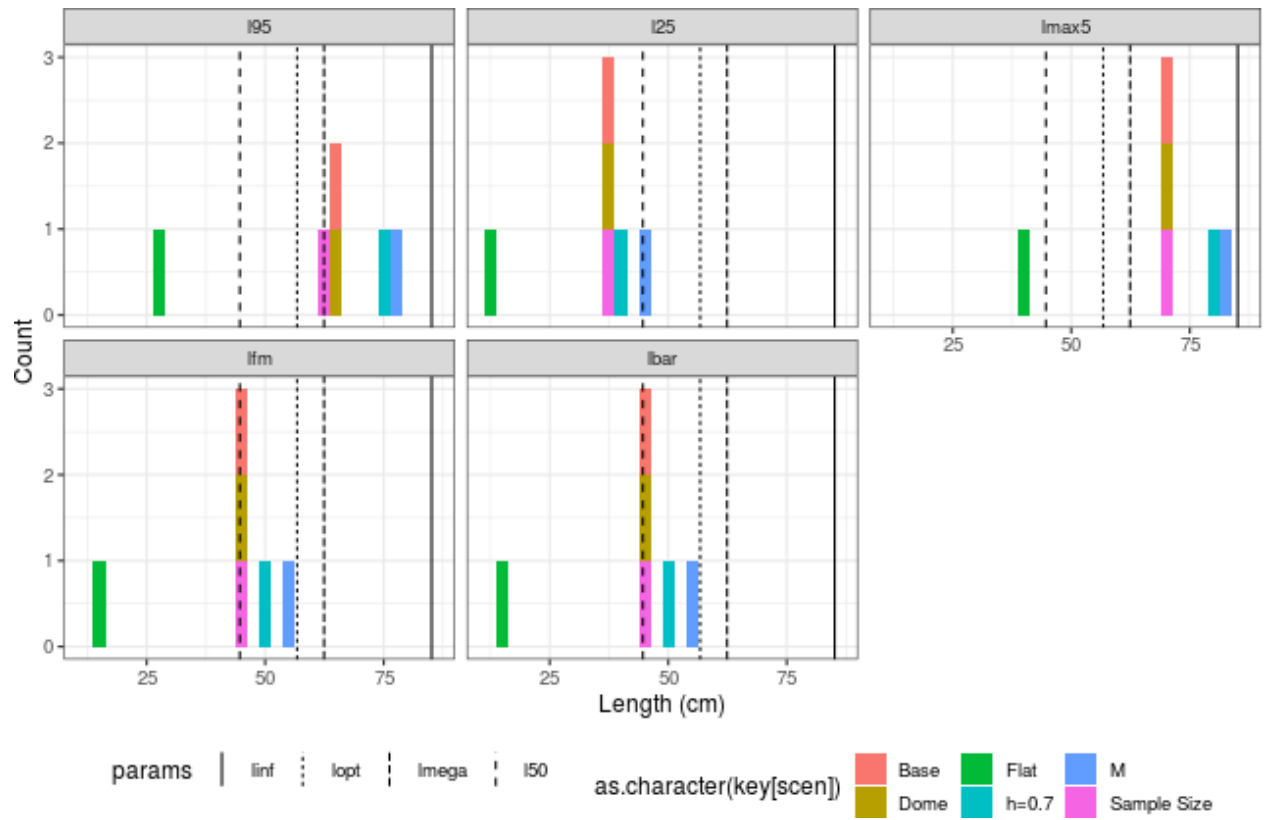


Figure 6.



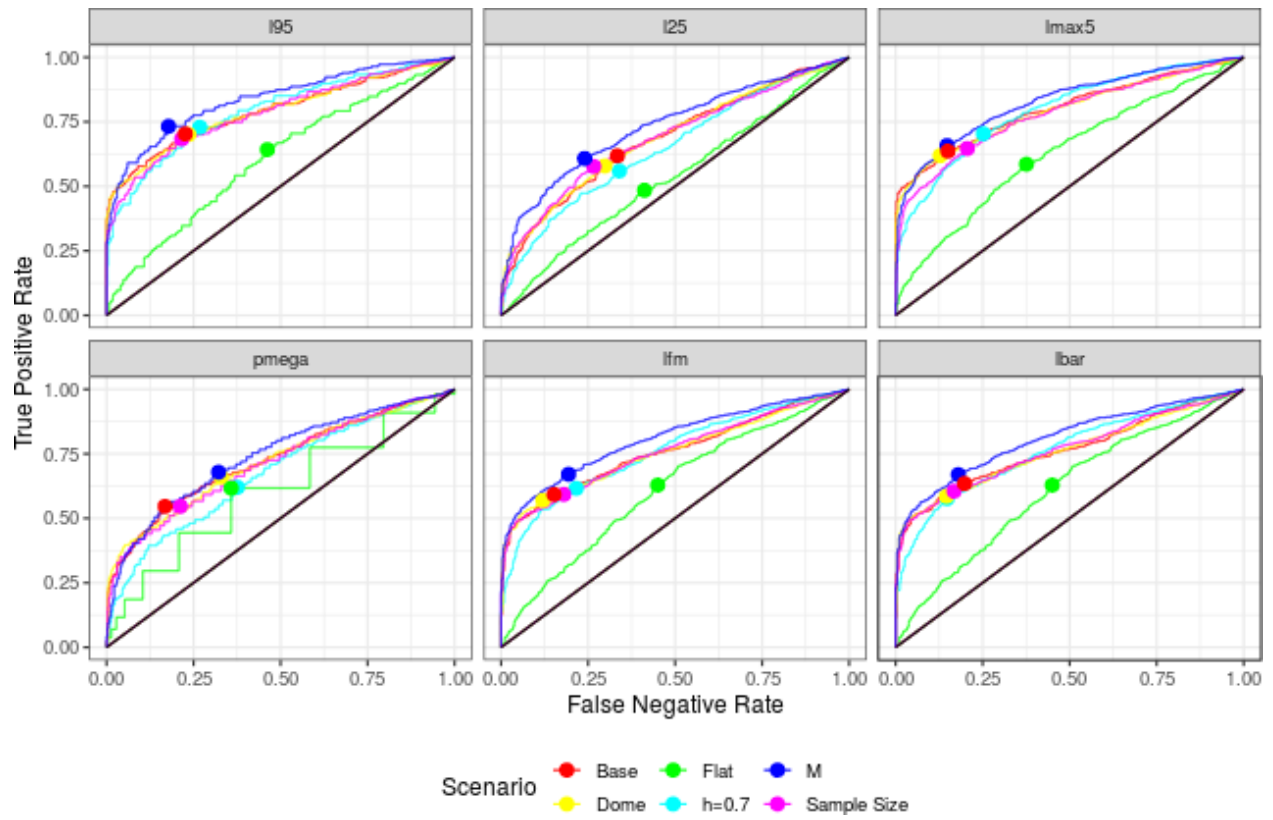
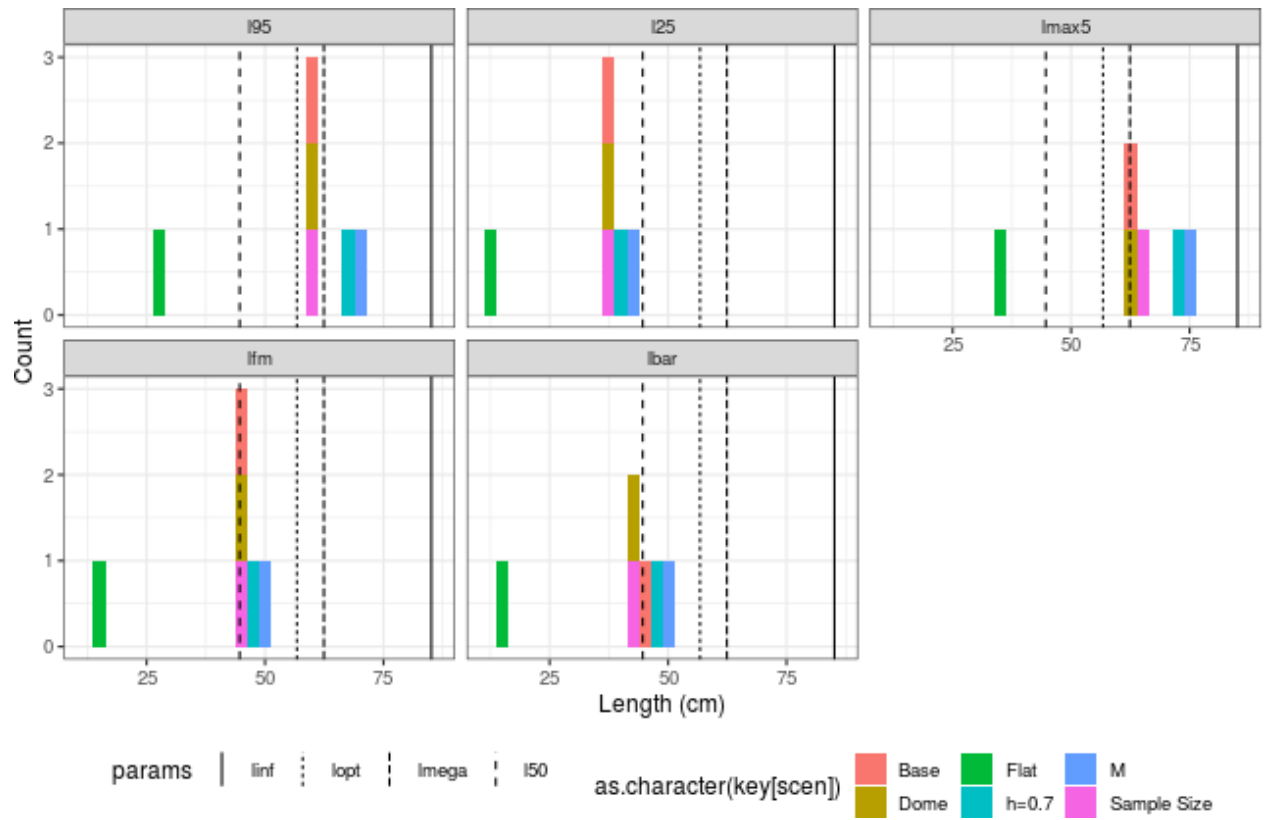


Figure 7.



## References

## Session Info

R version 3.6.1 (2019-07-05)  
Platform: x86\_64-pc-linux-gnu (64-bit)  
Running under: Ubuntu 16.04.5 LTS  
  
Matrix products: default  
BLAS: /usr/lib/libblas/libblas.so.3.6.0  
LAPACK: /usr/lib/lapack/liblapack.so.3.6.0

locale:  
[1] LC\_CTYPE=en\_US.UTF-8 LC\_NUMERIC=C  
[3] LC\_TIME=en\_GB.UTF-8 LC\_COLLATE=en\_US.UTF-8  
[5] LC\_MONETARY=en\_GB.UTF-8 LC\_MESSAGES=en\_US.UTF-8  
[7] LC\_PAPER=en\_GB.UTF-8 LC\_NAME=C  
[9] LC\_ADDRESS=C LC\_TELEPHONE=C  
[11] LC\_MEASUREMENT=en\_GB.UTF-8 LC\_IDENTIFICATION=C

attached base packages:  
[1] stats graphics grDevices utils datasets methods base

other attached packages:  
[1] spatstat\_1.61-0 rpart\_4.1-15 nlme\_3.1-141  
[4] spatstat.data\_1.4-0 LBSPR\_0.1.3 popbio\_2.4.4  
[7] GGally\_1.4.0 reshape\_0.8.8 dplyr\_0.8.3  
[10] plyr\_1.8.4 ggplotFL\_2.6.6 mydas\_1.1.6  
[13] FLife\_3.3.1 Flasher\_0.5.3 FLFishery\_0.1.5  
[16] FLBRP\_2.5.3 ggplot2\_3.2.1 FLCore\_2.6.13  
[19] iterators\_1.0.12 lattice\_0.20-38 knitr\_1.24

loaded via a namespace (and not attached):  
[1] tidyselect\_0.2.5 xfun\_0.9 purrr\_0.3.2  
[4] splines\_3.6.1 colorspace\_1.4-1 spatstat.utils\_1.13-0  
[7] htmltools\_0.3.6 stats4\_3.6.1 mgcv\_1.8-28  
[10] yaml\_2.2.0 rlang\_0.4.0 pillar\_1.4.2  
[13] glue\_1.3.1 withr\_2.1.2 RColorBrewer\_1.1-2  
[16] stringr\_1.4.0 munsell\_0.5.0 gtable\_0.3.0  
[19] codetools\_0.2-16 evaluate\_0.14 labeling\_0.3  
[22] Rcpp\_1.0.2 tensor\_1.5 scales\_1.0.0  
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[28] gridExtra\_2.3 digest\_0.6.20 stringi\_1.4.3  
[31] polyclip\_1.10-0 grid\_3.6.1 tools\_3.6.1  
[34] goftest\_1.1-1 magrittr\_1.5 lazyeval\_0.2.2  
[37] tibble\_2.1.3 crayon\_1.3.4 tidyr\_0.8.3  
[40] pkgconfig\_2.0.2 MASS\_7.3-51.4 Matrix\_1.2-17  
[43] assertthat\_0.2.1 rmarkdown\_1.15 rstudioapi\_0.10  
[46] R6\_2.4.0 compiler\_3.6.1