Compare CASAL & Casal2 for the HOK assessment

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Comparing CASAL mpd with Casal2 models

Comparing CASAL and Casal2 models for the modified stock assessment. This model differs from the actual assessment by two key points. First sex is ignored in this assessment, and secondly the original assessment uses length based selectivities.

The firsrt thing we want to confirm is that when run deterministically with the exact same parameters (\texttt{casal2 -r -i casal_pars.txt > run.log}) that they give the same initial partition, SSB and expected values as CASAL. You should always look to confirm if the initial age or length structure is correct. If this isn't correct it suggests that either growth, movement or natural mortality are incorrectly specified (assuming you are using an equilibrium age structure).

```
library(casal)
library(casal2)
```

```
##
## Attaching package: 'casal2'
```

```
## The following objects are masked from 'package:casal':
##
##     extract.mcmc, extract.mpd
```

```
library(xtable)
## bring in functions
source("AuxillaryFunsToincludeInLibrary.r")

#cas_mpd = casal::extract.mpd("../HOK/CASAL/estimate.log")
cas_mpd = casal::extract.mpd("../HOK/CASAL/run.log")
#cas_orig = casal::extract.mpd("../HOK/CASAL/orig_run.log")
cas2_mpd = casal2::extract.mpd("../HOK/Casal2/run.log")
```

```
## loading a run from -i format
```

```
## look at B0
cas_mpd$quantities$B0
```

```
## $E
## [1] 555126
##
## $W
## [1] 1133630
```

```
cas2_mpd$Recruit_E$`1`$b0
```

```
## [1] 555126
```

```
cas2_mpd$Recruit_W$`1`$b0
```

```
## [1] 1133630
```

```
## look at R0
cas_mpd$quantities$R0$E - cas2_mpd$Recruit_E$`1`$r0
```

```
## [1] 0
```

```
cas_mpd$quantities$R0$W - cas2_mpd$Recruit_W$`1`$r0
```

```
## [1] 0
```

```
# look at m
cas_mpd$free$natural_mortality.all
```

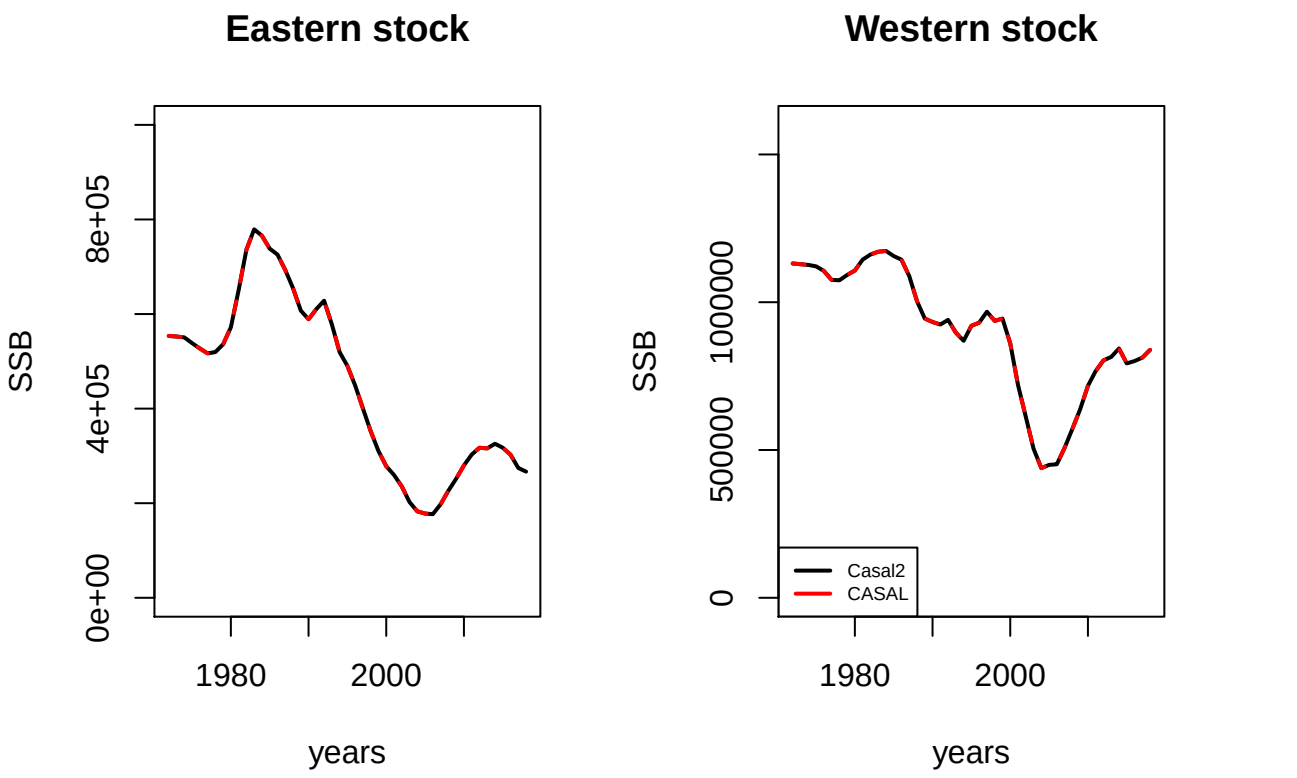
```
## [1] 0.295979
```

```
cas2_mpd$Mortality$`1`$m
```

```
## [1] 0.295979 0.295979 0.295979 0.295979 0.295979
```

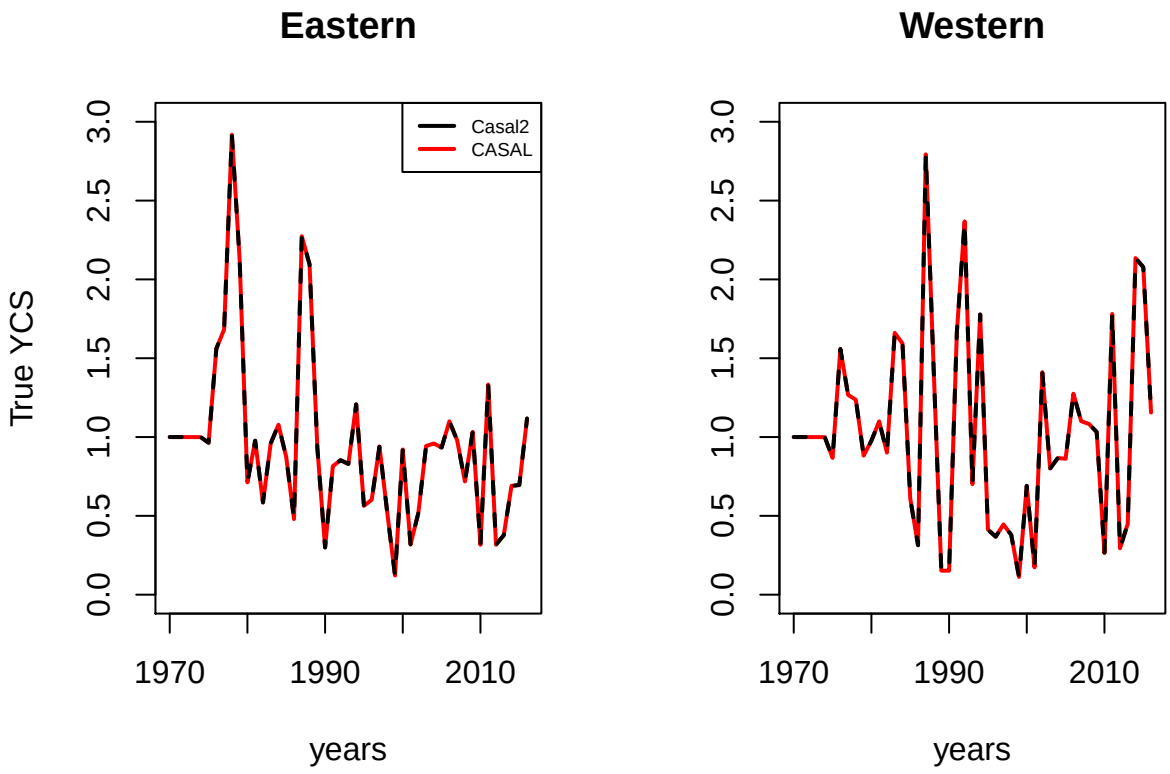
```
# plot SSB
cas2_ssb = plot.derived_quantities(cas2_mpd, "SSB", plot.it = F)
par(mfrow = c(1,2))
plot(rownames(cas2_ssb), cas2_ssb[,"SSB_E"], ylim = c(0,1e6), lwd = 2, type = "l",
     xlab = "years", ylab = "SSB", main = "Eastern stock")
lines(rownames(cas2_ssb), cas_mpd$quantities$SSBs$E, lty = 2, lwd = 2, col = "red")


plot(rownames(cas2_ssb), cas2_ssb[,"SSB_W"], ylim = c(0,1.6e6), lwd = 2, type = "l",
     xlab = "years", ylab = "SSB", main = "Western stock")
lines(rownames(cas2_ssb), cas_mpd$quantities$SSBs$W, lty = 2, lwd = 2, col = "red")
legend('bottomleft', legend = c("Casal2","CASAL"),col = c("black","red"), lwd = 2, cex = 0.6)
```



```
## Recruitment
par(mfrow = c(1,2))
plot(cas_mpd$quantities$true_YCS$year, cas_mpd$quantities$true_YCS$E,
     type = "l", lwd = 2, col = "red", ylab  = "True YCS", xlab = "years",
     ylim = c(0,3), main = "Eastern")
lines(cas2_mpd$Recruit_E$`1`$ycs_years, cas2_mpd$Recruit_E$`1`$true_ycs,
      col = "black", lwd =2 ,lty = 2)
legend('topright', legend = c("Casal2","CASAL"),col = c("black","red"), lwd = 2, cex = 0.6)

plot(cas_mpd$quantities$true_YCS$year, cas_mpd$quantities$true_YCS$W,
     type = "l", lwd = 2, col = "red", ylab  = "", xlab = "years",
     ylim = c(0,3), main = "Western")
lines(cas2_mpd$Recruit_W$`1`$ycs_years, cas2_mpd$Recruit_W$`1`$true_ycs, col = "black", lwd =2,
      lty = 2)
```



So this looks like the process dynamics are doing the right thing, lets look at how Casal2 is generating fits to observations, and the likelihood contribution.

```
cas_obj = cas_mpd$objective.function$components
cas2_obj = split_obj(cas2_mpd, label = "objective") ## custom function,
```

```
## Warning in split_obj(cas2_mpd, label = "objective"): You may have missed
## a component of the objective function difference between total and sum >
## 0.001
```

```
sum(cas2_obj$Value) - cas2_mpd$objective$`1`$values["total_score"]
```

total_score 1946.538

```
cas2_mpd$objective$`1`$values["total_score"]
```

total_score 1946.54

```
obs_across_both = sum(cas_obj$label %in% cas2_obj$Label)
comp = matrix(NA, nrow = obs_across_both, ncol = 3)
colnames(comp) = c("CASAL", "Casal2","Diff")
labels = cas_obj$label[cas_obj$label %in% cas2_obj$Label]
nonlabels = cas_obj$label[!cas_obj$label %in% cas2_obj$Label]

rownames(comp) = labels
for(i in 1:obs_across_both) {
  comp[i,1] = cas_obj$value[cas_obj$label == labels[i]]
  comp[i,2] = cas2_obj$Value[cas2_obj$Label == labels[i]]
  comp[i,3] = comp[i,1] - comp[i,2]
}
tab = xtable(comp, digits = 8, caption = "Comparison of Casal2 and CASAL objective function contributio
print(tab)
```

% latex table generated in R 3.6.1 by xtable 1.8-4 package % Fri Nov 15 13:57:53 2019

	CASAL	Casal2	Diff
CRsumbio	-31.03190000	-31.03193750	0.00003750
CSacous	-9.83522000	-9.83522764	0.00000764
SAautbio	-3.98378000	-3.98378000	0.00000000
SAsumbio	-6.14646000	-6.14646200	0.00000200
WCacous	-5.91560000	-5.91560480	0.00000480
CRsumage	323.85000000	323.84998000	0.00002000
SAautage	35.11740000	35.11750000	-0.00010000
SAsumage	221.14900000	221.14920000	-0.00020000
EnspOLF	24.27550000	24.27546000	0.00004000
Enspage	256.06900000	256.06888000	0.00012000
Espage	581.50200000	581.50240000	-0.00040000
WnspOLF	70.24990000	70.24978000	0.00012000
Wnspage	157.00400000	157.00382000	0.00018000
Wspage	364.75100000	364.75082000	0.00018000
pspawn	-13.12890000	-13.12891000	0.00001000
pspawn_1993	-6.01525000	-6.01525000	0.00000000
YCS.eq.16	0.00005760	0.00005760	0.00000000
sp.migr	0.01323880	0.01323880	0.00000000

Table 1: Comparison of Casal2 and CASAL objective function contributions for the main data sets.

Compare Casal2 and CASAL estimation

```
cas_mpd = casal::extract.mpd("../HOK/CASAL/estimate.log")
cas2_mpd = casal2::extract.mpd("../HOK/Casal2/estimate.log")
```

loading a run from -i format

```
## look at B0
cas_mpd$quantities$B0
```

$E [1] 555146

$W [1] 1133660

```
cas2_mpd$Recruit_E$`1`$b0
```

[1] 555124

```
cas2_mpd$Recruit_W$`1`$b0
```

[1] 1133680

```
## look at R0
cas_mpd$quantities$R0$E - cas2_mpd$Recruit_E$`1`$r0
```

[1] -9000

```
cas_mpd$quantities$R0$W - cas2_mpd$Recruit_W$`1`$r0
```

[1] -77000

```
# look at m
cas_mpd$free$natural_mortality.all
```

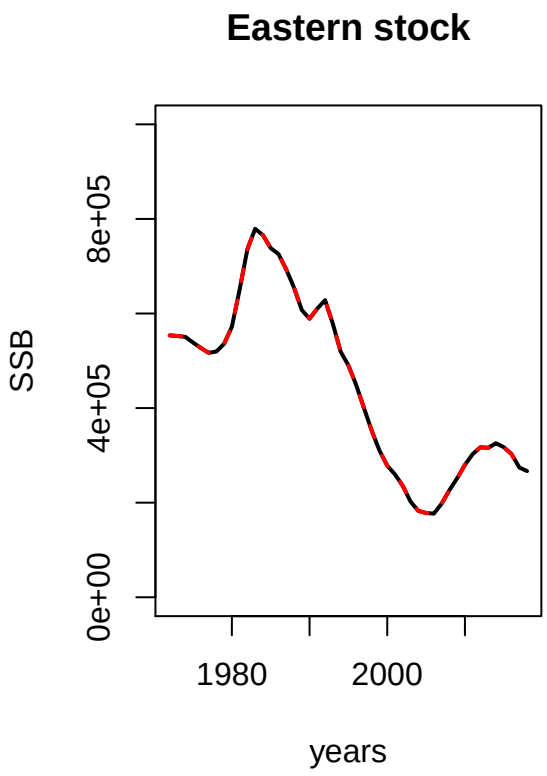
[1] 0.295979

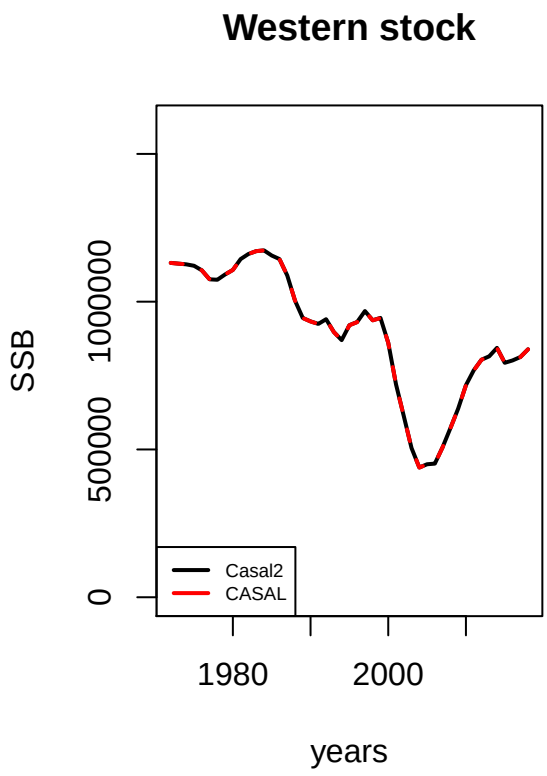
```
cas2_mpd$Mortality$`1`$m
```

[1] 0.295985 0.295985 0.295985 0.295985 0.295985

```
# plot SSB
cas2_ssb = plot.derived_quantities(cas2_mpd, "SSB", plot.it = F)
par(mfrow = c(1,2))
plot(rownames(cas2_ssb), cas2_ssb[,"SSB_E"], ylim = c(0,1e6), lwd = 2, type = "l",
     xlab = "years", ylab = "SSB", main = "Eastern stock")
lines(rownames(cas2_ssb), cas_mpd$quantities$SSBs$E, lty = 2, lwd = 2, col = "red")


plot(rownames(cas2_ssb), cas2_ssb[,"SSB_W"], ylim = c(0,1.6e6), lwd = 2, type = "l",
     xlab = "years", ylab = "SSB", main = "Western stock")
lines(rownames(cas2_ssb), cas_mpd$quantities$SSBs$W, lty = 2, lwd = 2, col = "red")
legend('bottomleft', legend = c("Casal2","CASAL"),col = c("black","red"), lwd = 2, cex = 0.6)
```



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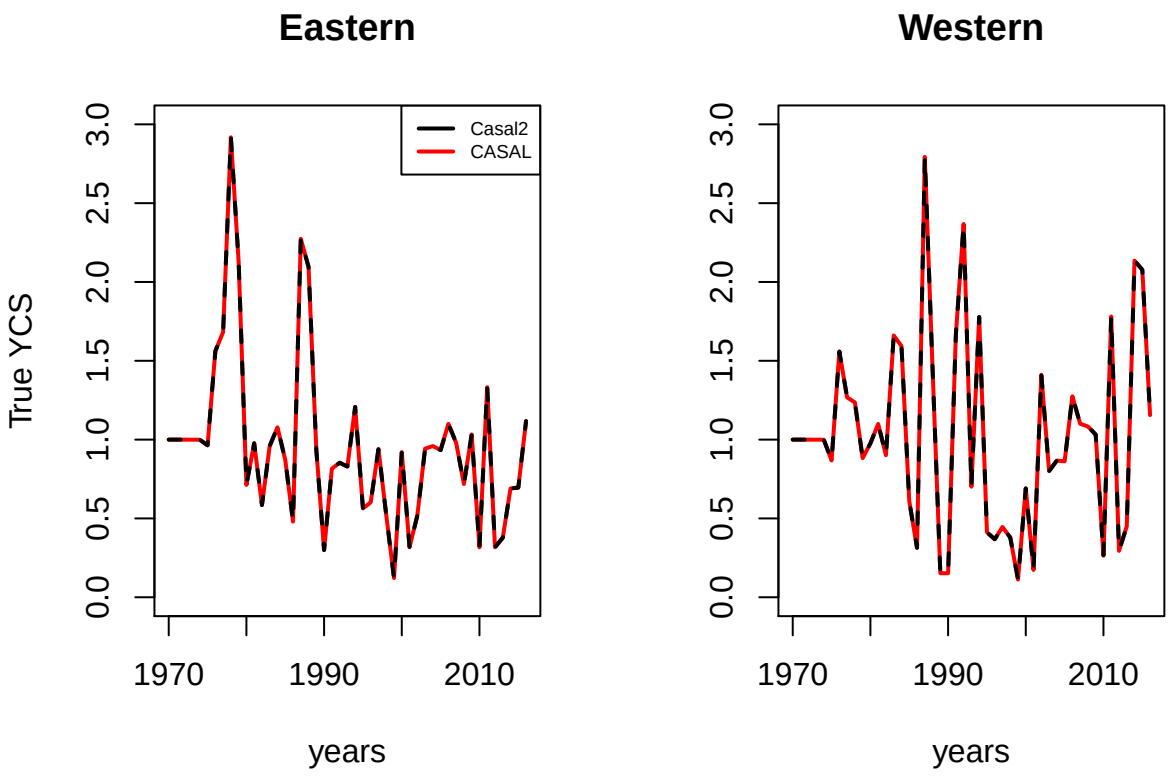
     type = "l", lwd = 2, col = "red", ylab  = "True YCS", xlab = "years",
     ylim = c(0,3), main = "Eastern")
lines(cas2_mpd$Recruit_E$`1`$ycs_years, cas2_mpd$Recruit_E$`1`$true_ycs,
      col = "black", lwd =2 ,lty = 2)
legend('topright', legend = c("Casal2","CASAL"),col = c("black","red"), lwd = 2, cex = 0.6)

plot(cas_mpd$quantities$true_YCS$year, cas_mpd$quantities$true_YCS$W,
     type = "l", lwd = 2, col = "red", ylab  = "", xlab = "years",
     ylim = c(0,3), main = "Western")
lines(cas2_mpd$Recruit_W$`1`$ycs_years, cas2_mpd$Recruit_W$`1`$true_ycs, col = "black", lwd =2,
      lty = 2)
```



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cas2_obj = split_obj(cas2_mpd, label = "objective") ## custom function,
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labels = cas_obj$label[cas_obj$label %in% cas2_obj$Label]
nonlabels = cas_obj$label[!cas_obj$label %in% cas2_obj$Label]

rownames(comp) = labels
for(i in 1:obs_across_both) {
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  comp[i,2] = cas2_obj$Value[cas2_obj$Label == labels[i]]
  comp[i,3] = comp[i,1] - comp[i,2]
```

```
}
tab = xtable(comp, digits = 8, caption = "Comparison of Casal2 and CASAL objective function contributio
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CRsumbio	-31.03180000	-31.03193030	0.00013030
CSacous	-9.83545000	-9.83556210	0.00011210
SAautbio	-3.98372000	-3.98367000	-0.00005000
SAsumbio	-6.14623000	-6.14617600	-0.00005400
WCacous	-5.91567000	-5.91571500	0.00004500
CRsumage	323.85000000	323.84966000	0.00034000
SAautage	35.11750000	35.11770000	-0.00020000
SAsumage	221.14900000	221.14960000	-0.00060000
EnspOLF	24.27560000	24.27556000	0.00004000
Enspage	256.06900000	256.06812000	0.00088000
Espage	581.50200000	581.50200000	-0.00000000
WnspOLF	70.24990000	70.25004000	-0.00014000
Wnspage	157.00400000	157.00374000	0.00026000
Wspage	364.75100000	364.75133000	-0.00033000
pspawn	-13.12890000	-13.12909000	0.00019000
pspawn_1993	-6.01527000	-6.01525000	-0.00002000
YCS.eq.16	0.00005698	0.00005700	-0.00000003
sp.migr	0.01323760	0.01324570	-0.00000810

Table 2: Comparison of Casal2 and CASAL objective function contributions for the main data sets.