Release notes for Stock Synthesis 3.30.18

September 2021

Greetings Stock Synthesis Users,

This release of Stock Synthesis (3.30.18.00) includes both augmentations and bug fixes. Please note that between releases, fixes will also be posted to github releases. The most notable changes in 3.30.18 are:

- A new fleet type (4) provides the capability to define an entity as a predator that adds the predation mortality to the base natural mortality.
- A new Fleet-specific F method = 4. With this approach, some fleets can stay in hybrid F mode while others transition to parameters. Method 4 is now a recommended superset of methods 2 and 3.
- An option to produce output for F at Blimit, where Blimit is a fraction of Bmsy.
- We no longer are updating the executable to translate 3.24 models to 3.30 models (typically this executable has been named ss_trans.exe). To convert, the 3.30.17 version of the translation executable can be used, the user can convert to newer versions of Stock Synthesis from there.

We advise all users to update to this version of Stock Synthesis to take advantage of augmentations and bug fixes. Remember to update your local version of r4ss, SSI and the User Manual also as these work closely together.

There are no mandatory input changes with version 3.30.18.00.

The full list of changes is in the change log, and an abbreviated list of changes since the last SS release is posted at the end of this message. Thank you to all users who reported bugs or requested features - your suggestions help us improve Stock Synthesis for everyone.

Vlab updates: We are providing more resources on Github rather than on the website. See the Stock Synthesis homepage for the latest links. Reminder to update your link to VLAB.

- Old host name: **vlab.ncep.noaa.gov** (No longer valid)
- New host name: **vlab.noaa.gov** (valid)
- Full address: https://vlab.noaa.gov/web/stock-synthesis/home

GUI - Stock Synthesis Interface (SSI) updates: The GUI has been updated to accommodate changes for this release of Stock Synthesis.

ss3sim updates: The main branch of the ss3sim github repository has been updated to maintain compatibility with Stock Synthesis 3.30.18. See the ss3sim vignettes for information on getting started.

r4ss updates: r4ss has been updated to maintain compatibility with Stock Synthesis 3.30.18. The github main branch is considered the most reliable and up-to-date version.

Additional tools for SS updates:

- [SSMSE](), a tool for using SS operating models, is now available. Get started with the example in the [readme]() or tune into [a seminar on SSMSE]() on October 7 from 3-4 EDT.

SS User Manual updates: The latest version of the [user manual]() includes documentation of new features in the release and a thorough update of information on time-varying parameters. A citable version of the manual is available and can be cited as:

> Methot, R. D., Jr., C. R. Wetzel, I. G. Taylor, and K. Doering. 2020. Stock Synthesis User Manual Version 3.30.15. U.S. Department of Commerce, NOAA Processed Report NMFS-NWFSC-PR-2020-05. https://doi.org/10.25923/5wpn-qt71

An [html version]() of the user manual is now available.

Contact us: Please do not hesitate to report bugs, ask a question about SS, or request a feature by posting on the [forums](), opening an [issue]() (for those with github accounts), or emailing the SS team at [nmfs.stock.synthesis@noaa.gov]().

Change log since last release:

See *[Change_log_for_SS_3.30.xlsx]()* for more details.

Features

- Fishing mortality. [#33](). Fleet-specific F method = 4. With this approach some fleets can stay in hybrid F mode while others transition to parameters. See [details]().
- Forecast. [#188](). Add output for F at Blimit, where Blimit is a fraction of Bmsy. See [details]().
- Fleet characteristics. [#45](). Fleet_type = 4 provides the capability to define an entity as a predator that adds M2 (i.e., the predation mortality) to the base natural mortality. See [details]().

Corrections and Revisions

- Build. [#151](). We will no longer update the SStrans code. If someone still needs to convert from 3.24 to 3.30, they will need to use the 3.30.17 version of the translation executable, then update manually from there.
- Fix. [#183](). Repair an indexing issue related to use of Dirichlet parameters for both length and age composition data.
- Fix. [#180](). Extra std-err was not implemented for combined age-length selectivity.

- Fix. [#181](#). Lorenzen M was not incrementing M by season.
- Fix. [#91](#). Lambda for equilibrium catch was mixed up with lambda for catch.

Fleet specific F details

A. Fleet-specific F method = 4. With this approach some fleets can stay in hybrid F mode while others transition to parameters. For example, bycatch fleets must start with parameters in phase 1, while other fishing fleets can use hybrid F or start with hybrid and transition to parameters at a fleet-specific designated phase. We believe this new method 4 is a superior superset to current methods 2 (all use parameters and all can start hybrid then switch to parameters) and 3 (all hybrid for all phases). Syntax is:

4	# F_Method: 1=Pope; 2=instan. F; 3=hybrid; 4=fleet-specific parm/hybrid (#4 is recommended)
2.9	# max F or harvest rate, depends on F_Method

```
# for Fmethod=4; read list of fleets needing parameters; syntax is:
fleet, F_starting_value (if start_PH=1), first PH for parms (99 to
stay in hybrid)
# for Fmethod=4; then read N tuning loops for hybrid fleets
```

# Fleet	start-F	first-parm-phase
1	0.05	1
2	0.20	99
3	0.10	1
-9999	1	1
4	#_number of tuning loops for hybrid fleets; 4 good; 3 faster	

F at Blimit details

Add output for F at Blimit, where Blimit is a fraction of Bmsy. This will aid in reporting of situations in which the stock is approaching an overfished condition at Blimit. Input format in forecast.ss looks like:

3	# Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy; 2=calc F_spr,F0.1,F_msy; 3=add F_Blimit

2	# MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt) or F0.1; 4=set to F(endyr)
0.4	# SPR target (e.g. 0.40)
.342	# Biomass target (e.g. 0.40)
-0.25	# COND: Do_Benchmark==3; Blimit as fraction of Bmsy (neg value to use as frac of Bzero) (e.g. 0.50)

Output in Mgmt_Quant is also conditional and looks like:

Label	value	se	comment
B_MSY/SSB_unfished	0.29	0	existing output just preceding the new output
SSB_Blim	13103.	0	where this is the SSB at 0.25 of Bzero
annF_Blim	0.172	0	this is the annual F that would reduced SSB to SSB_Blim
Dead_Catch_Blim	3630.	0	this is the dead catch that would result from the F
ForeCatch_2002	713.	0	existing output that now follows the new, conditional output

The F associated with Blimit is also used in the SPR/YPR profile and shows up as item 8 in sequence of included profiles.

Predation mortality details

Fleet_type = 4 provides the capability to define an entity as a predator that adds M2 (i.e., the predation mortality) to the base natural mortality. This new capability means that previous use of bycatch fleets to mimic predators (or fish kills, e.g., due to red tide) will no longer be necessary. The problem with using a bycatch fleet as a predator was that it still created an "F" that was included in the reporting of total F even if the bycatch was not included in the MSY search.

For each fleet that is designated as a predator, a new MGparm is created. This parameter will have the label M2_pred1, where the "1" is the index for the predator (not the index of the fleet being used as a predator). More than one predator can be included.

If the model has > 1 season, it is normal to expect M2 to vary seasonally. Therefore, only if N seasons is >1, follow each M2 parameter with N season parameters to provide the seasonal multipliers. These are simple multipliers times M2, so at least one of these needs to have a non-estimated value. The set of multipliers can be used to set M2 to only operate in one season if desired. If there is more than one M2 fleet, each will have its own seasonal multipliers. If there is only 1 season in the model, then no multiplier lines are included. For example with four seasons:

```
#  M2 parameter for each predator fleet
 0  4 0.32 0.2 0.8 0   3 0 5 1991 2018 0 0 0 # M2_pred1
 0 10 1.00   1   1  0 -1 0 0    0    0 0 0 0 # M2_pred1_s1
 0 10 1.12   1   1  0  4 0 5 1991 2018 4 0 0 # M2_pred1_s2
 0 10 1.41   1   1  0  4 0 5 1991 2018 4 0 0 # M2_pred1_s3
 0 10 1.80   1   1  0  4 0 5 1991 2018 4 0 0 # M2_pred1_s4
```

M2 is age-specific, but not sex or morph specific. The value of the M2 parameter will be distributed across ages according to the selectivity for this fleet. In this example note that pred1 refers to the first predator inthe model, note the fleet number in which that predator has been configured. The resultant age-specific M2 is added to the base M to create a total age-specific M that operates in the model exactly as M has always operated.

Because M2 is a MGparm, it can be time-varying like any other MGparm. This is important because M2, as a component added to base M, will probably always need to be time-varying by blocks, random walk or linkage to external driver. A time series of M2 from an external source could be input by setting the M2 parameter to have a base value of 0.0 and linking to the time series in the environmental data section of the data file using an additive link. In addition, the relationship should have a fixed slope of 1.0 such that M2(y) = 0.0 + 1.0*M2_env_input(y).

Three types of data relevant to M2 can be input:

(1) total kill (as discard in the data file): M2 is a component of Z, so M2/Z can be used to calculate the amount of the total kill that is attributable to M2. This is completely analogous to calculating catch for the fishing fleets. The total kill (e.g., consumption) is output to the discard array. If data on the total kill by the M2 predator is available, it can be input as observed "discard" for this fleet and thus included in the total logL to estimate the magnitude of the M2 parameter.

(2) predator effort (as a survey index in the data file): M2 is a rate analogous to F, so the survey of F approach (survey units = 2) can be used to input predator abundance as an indicator of the "effort" that produced the M2. Like all surveys, this survey of M2 will also need a Q specification. Note that in the future we can explore improved options for this Q.

(3) predated age-length composition (as length or age composition data in the data file): M2 "eats" the modeled fish, so gut contents or other sources may have size and/or age composition data which may be input to estimate selectivity of the M2 source.

With the input of data on the time series of total kill or predator effort, it should be possible to estimate annual deviations around the base M2 for years with data. If the M2 time series is instead driven by environmental data, then also including data on kill or effort can provide a means to view consistency between the environmental time series and the additional data sets.

Output of M2 is found in a report.sso section labeled `predator(M2)`. In the example below, the M2 seasonal multiplier was defined to have random deviations by year. This allowed multipliers plus M2 itself to closely match the input consumption amounts (288 mt of consumption per season, the fit can be examined by looking at the discard output report).

```
Predator_(M2); Values_are_apical_M2;
total_M-at-age_(M1+M2)_reported_in_table_No_fishery_for_Z=M
Yr Era seas Seals_M2 Bio Num
1988 VIRG 1 0 0 0
1988 VIRG 2 0 0 0
1988 VIRG 3 0 0 0
1988 VIRG 4 0 0 0
1989 INIT 1 0 0 0
1989 INIT 2 0 0 0
1989 INIT 3 0 0 0
1989 INIT 4 0 0 0
1990 TIME 1 0.231649 286.944 23105.3
1990 TIME 2 0.260593 287.983 23243.8
1990 TIME 3 0.326182 288.17 23779.9
1990 TIME 4 0.417351 288.467 24445.6
```

Note that all existing reports of natural_mortality are the total (base M + M2) natural mortality.

The M2 parameter is active in the virgin year and initial equilibrium year, where the value of M2 in the start year is used. In the future, separate control of M2 for the initial equilibrium will be provided.

M2 is part of the total M used in the SPR and MSY benchmark calculations.

M2 is active in the forecast era, so be attentive to its configuration if it is time-varying.

Testing to date shows that this M2 feature can replicate previous results using bycatch fleets.