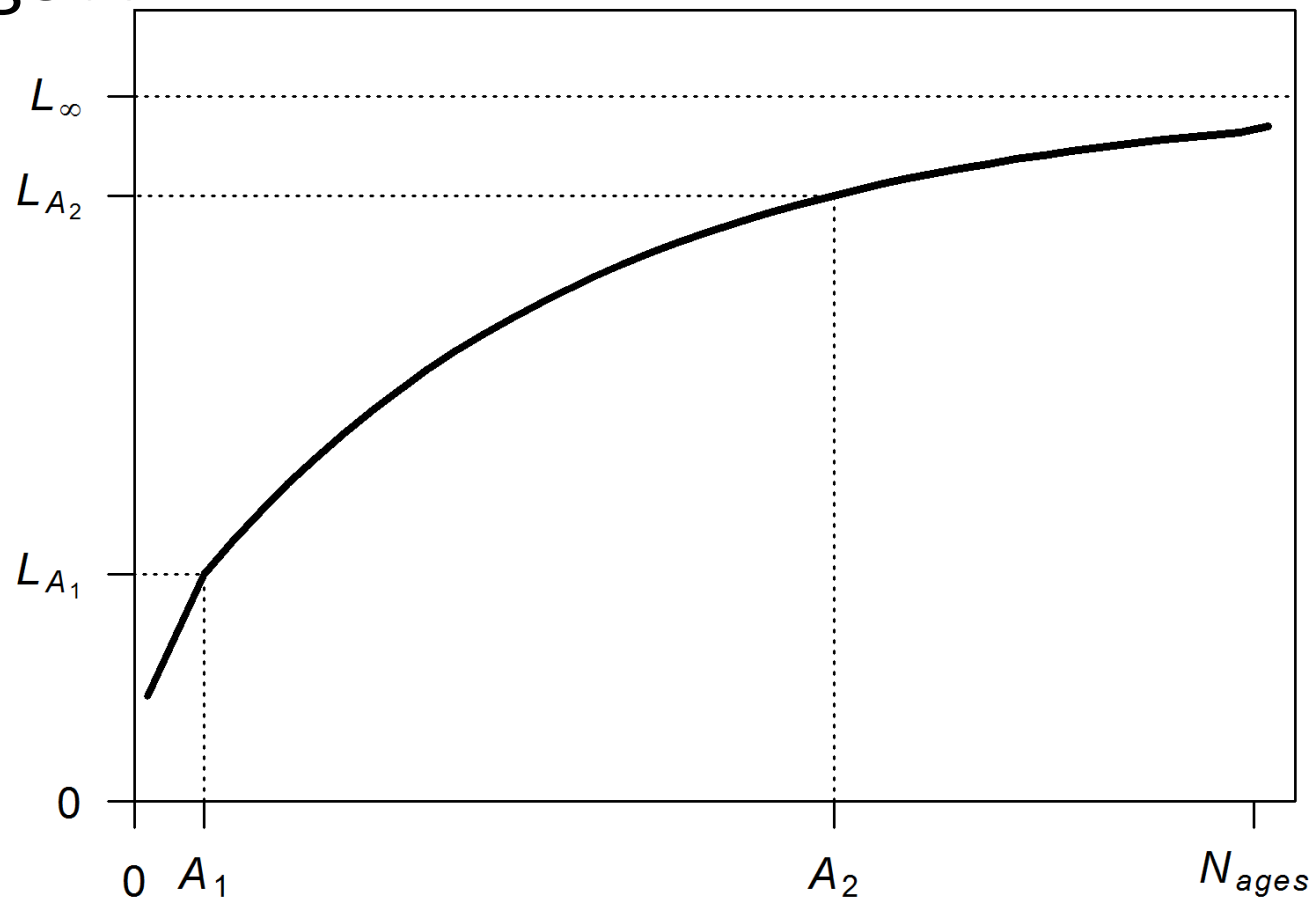


# Modeling growth in stock assessments using Stock Synthesis

Note: a longer version of this presentation from a 2014 CAPAM workshop is available at <https://github.com/iantaylor-NOAA/SSgrowth>

# Parameterization of growth: mean length

- Von Bertalanffy growth with 2 reference ages
- Linear starting from first length bin at age 0 to age  $A_1$



# Parameterization of growth: mean length

- Von Bertalanffy growth with 2 reference ages
- Linear starting from first length bin at age 0 to age A1

## ***1.5 Growth***

The mean size-at-age by gender at the start of each season for each growth morph is incremented across season as:

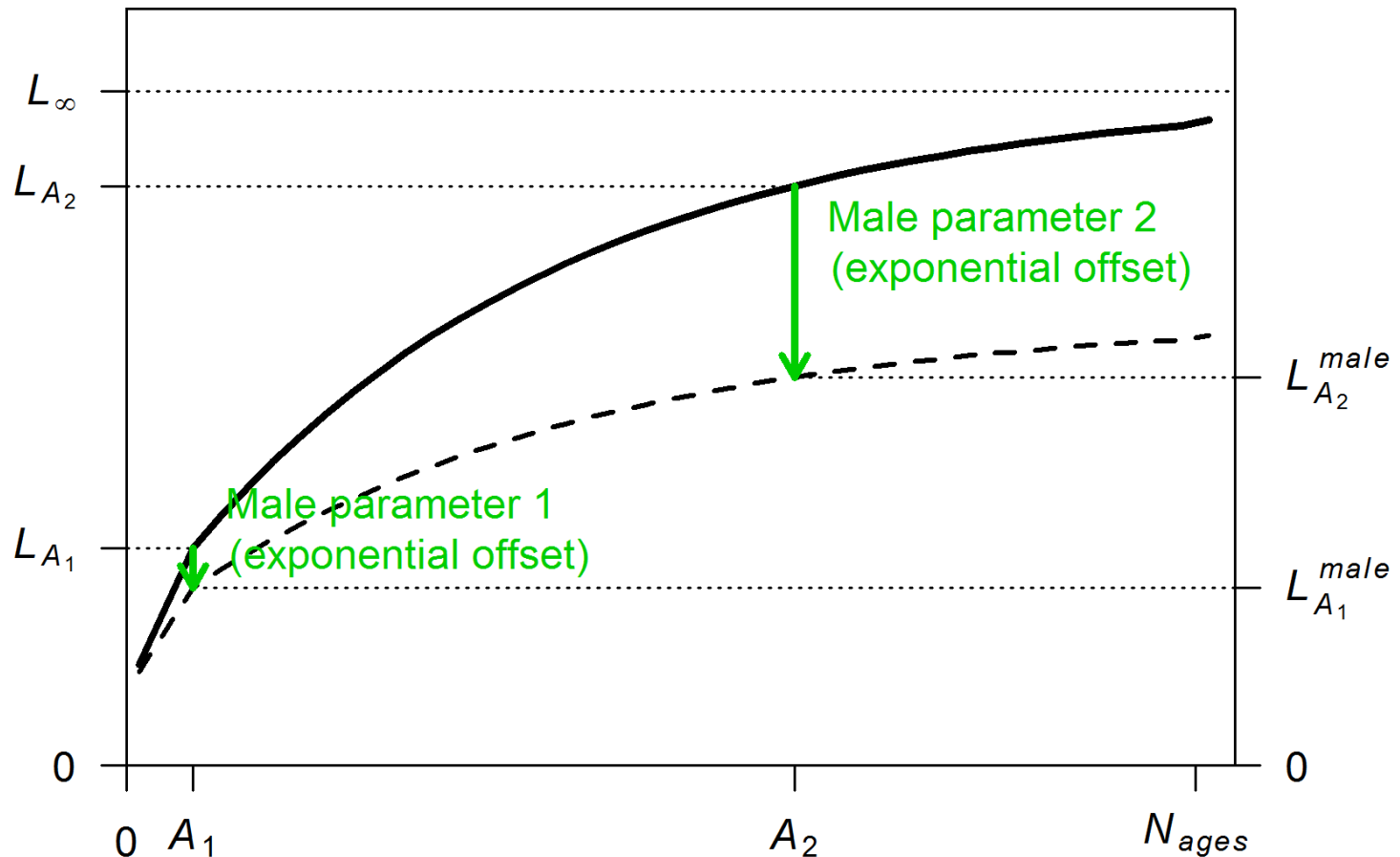
$$L_{t+1,\gamma,a} = L_{t,\gamma,a} + (L_{t,\gamma,a-k} - L_{\infty,\gamma})(e^{-k_\gamma} - 1) \quad \text{for } a < A \quad (\text{A.1.10})$$

The mean size at the start of the season for the plus-group is calculated based on a weighted average of fish moving into the plus-group and existing plus-group fish. This approach allows for a decline in the mean size of fish in the plus-group over time as fishing mortality reduces the numbers in the plus-group. It also prevents an instantaneous change in size of plus-group fish when growth parameters are allowed to be time-varying.

$$L_{t,\gamma,A} = \frac{N_{t,\gamma,A-1} \tilde{L}_{t,\gamma,A} + N_{t,\gamma,A} \left( L_{t,\gamma,A} + (L_{t,\gamma,A} - L_{\infty,\gamma})(e^{-k_\gamma} - 1) \right)}{N_{t,\gamma,A-1} + N_{t,\gamma,A}} \quad (\text{A.1.11})$$

# Parameterization of growth: mean length

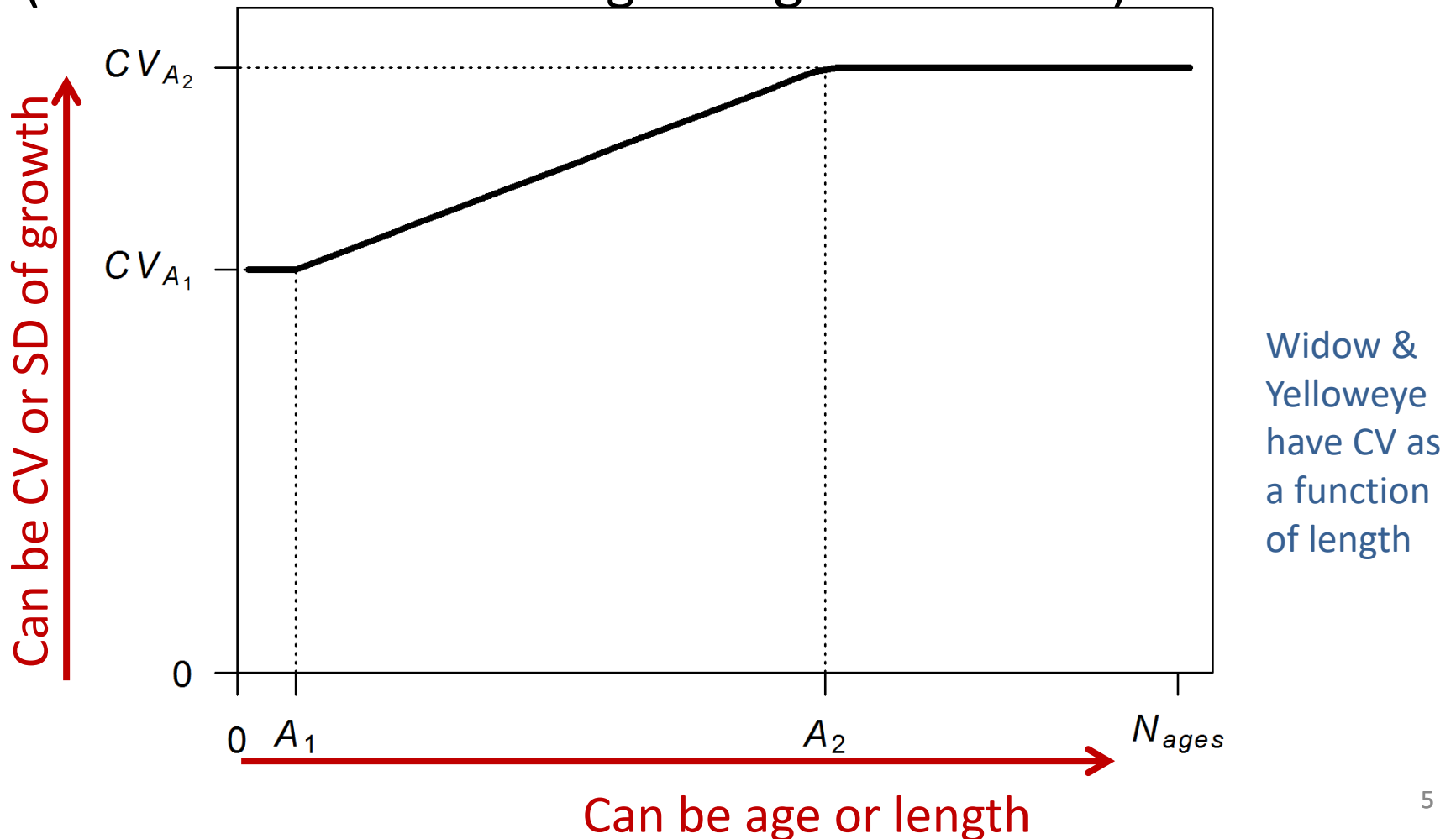
- Male growth can be separate parameters or exponential offsets



Widow has separate parameters for males, not offsets. Yelloweye is a single-sex model

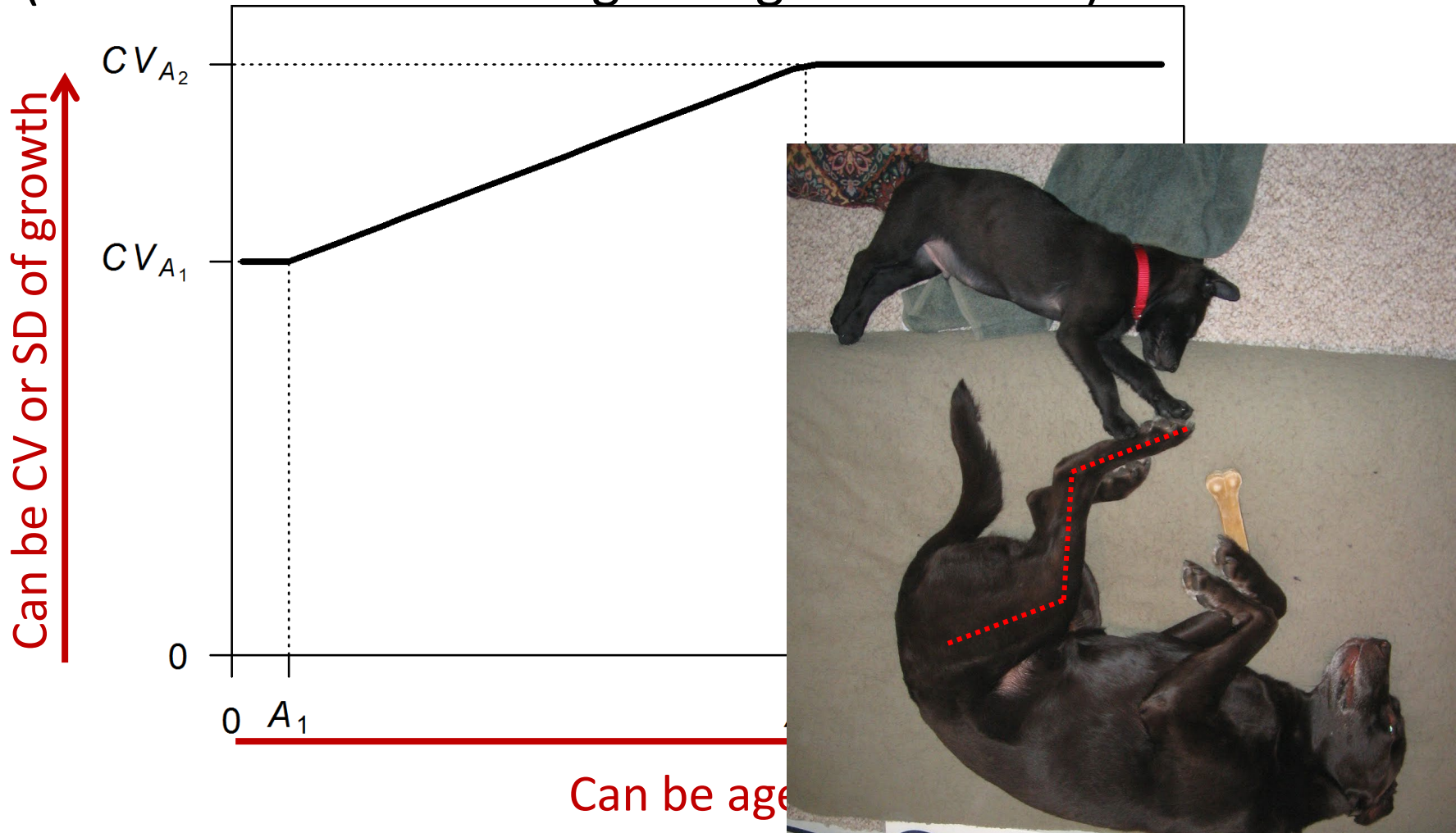
# Parameterization of growth: length variability

- Variability in length at age determined by 2-parameter “dogleg” function (eq. A.1.13 in M&W2013) (with same reference ages as growth curve)



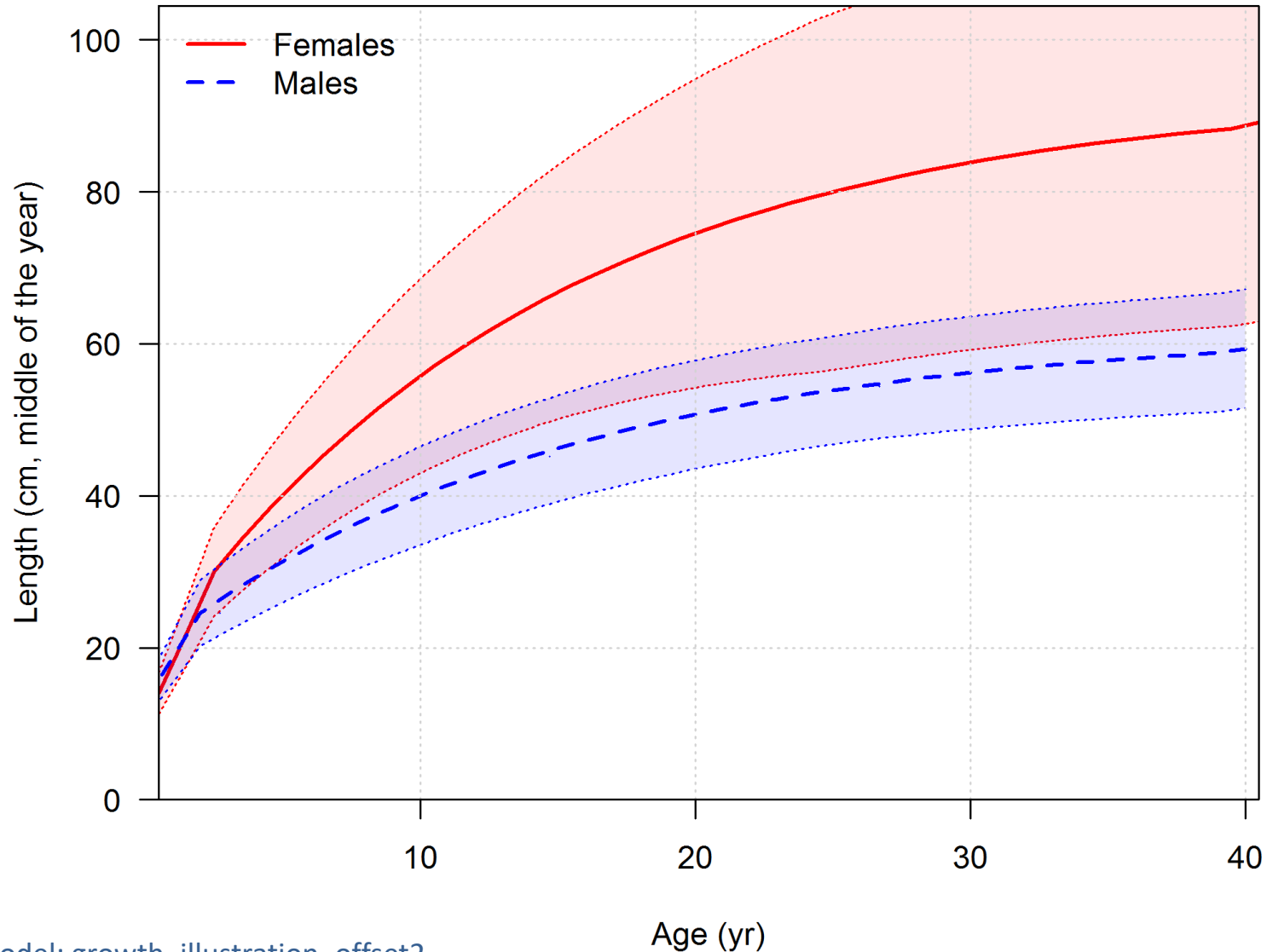
# Parameterization of growth: length variability

- Variability in length at age determined by 2-parameter “dogleg” function (eq. A.1.13 in M&W2013) (with same reference ages as growth curve)

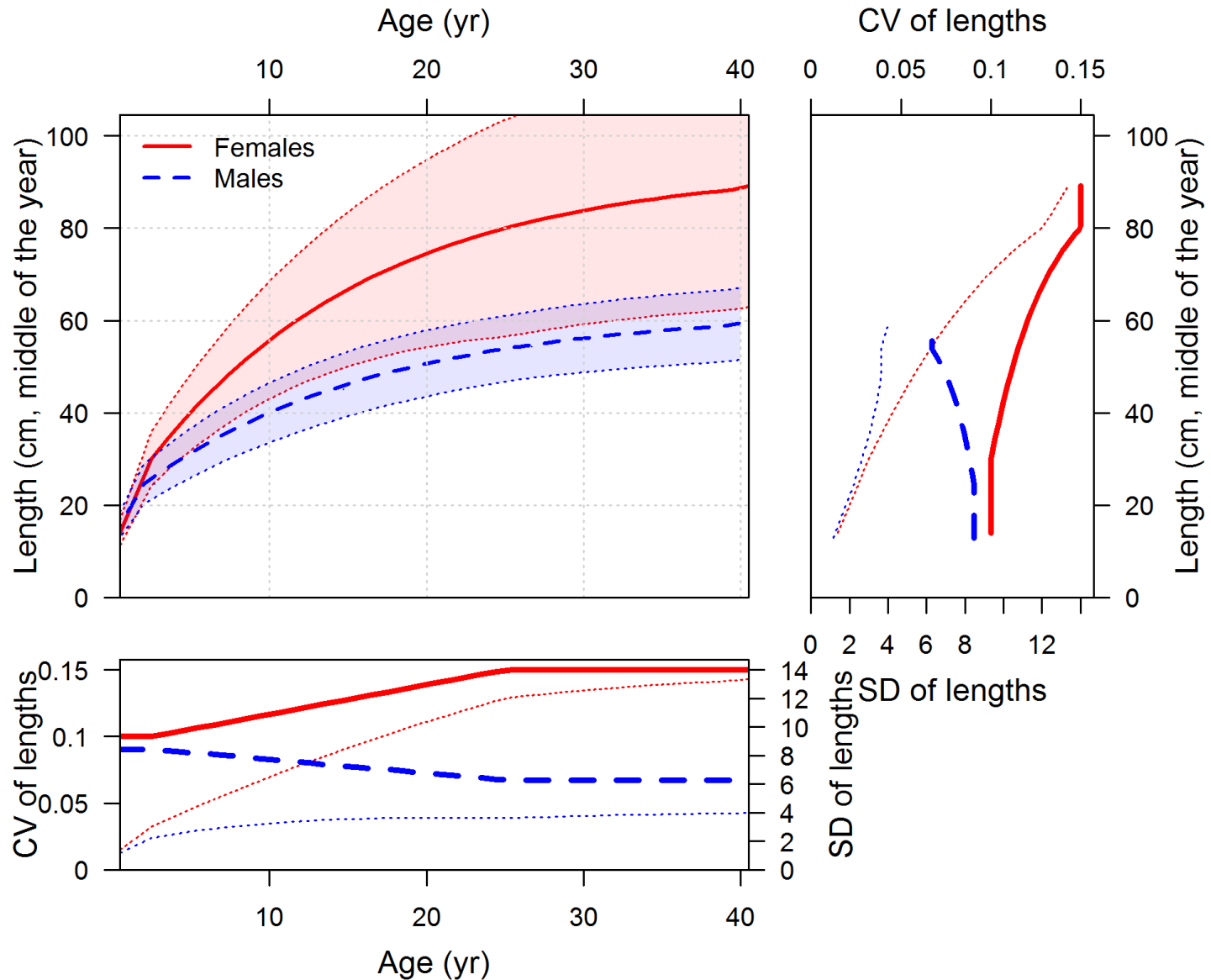


# Parameterization of growth: summary

Ending year expected growth (with 95% intervals)



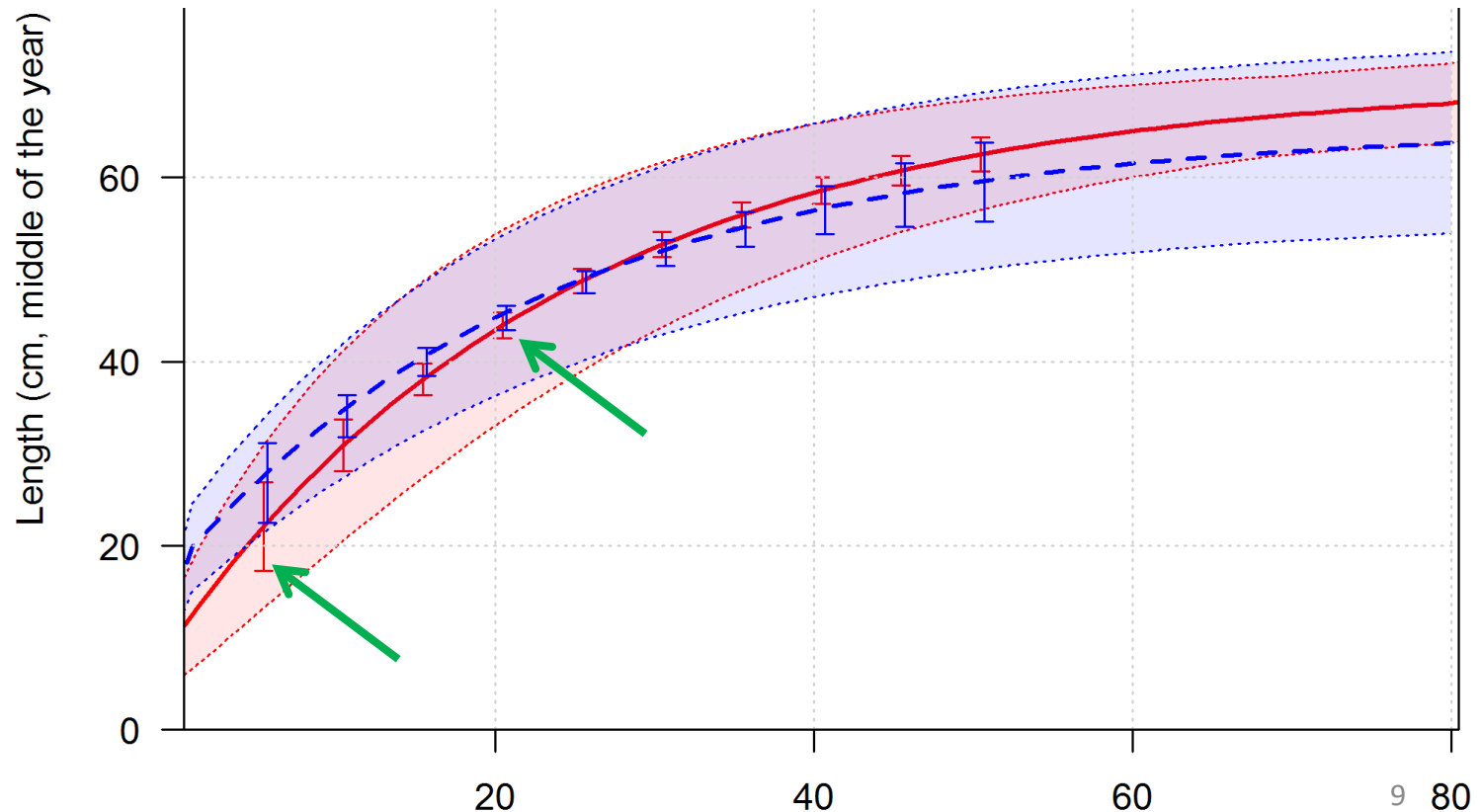
# Parameterization of growth: summary





# Parameterization of growth: uncertainty

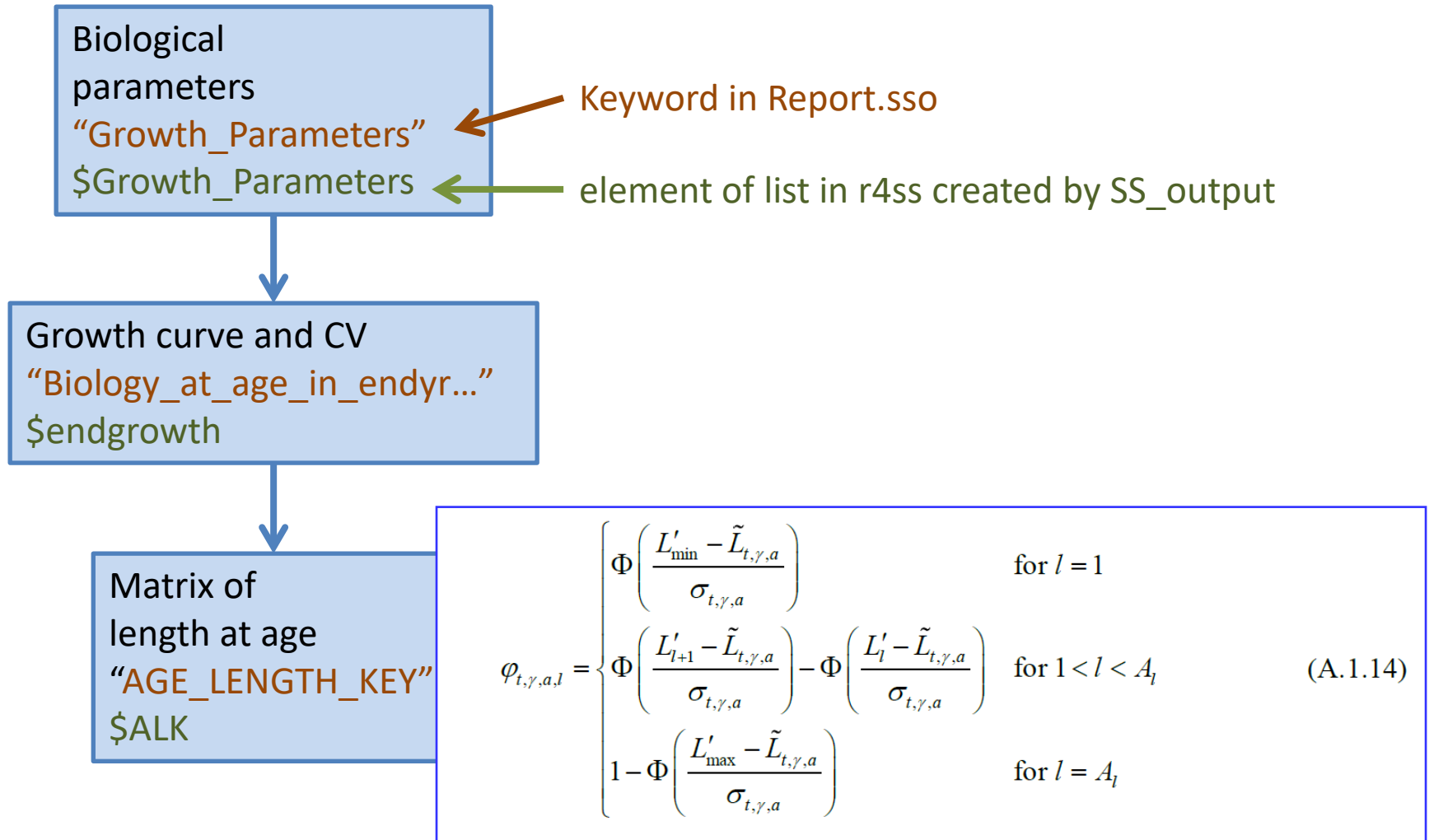
```
1          # (0/1) read specs for more stddev reporting
1  1 -1  2 # selex type (flt), len=1/age=2, year, N selex bins (4 vals)
1  10      # Growth pattern, N growth ages (2 values)
1 -1  2    # NatAge_area(-1 for all), NatAge_yr, N Natages (3 values)
-1 1       # vector with selex std bin picks
5 10 15 20 25 30 35 40 45 50 # vector with growth std bin picks
-1 1       # vector with NatAge std bin picks
999 # end of control file
```



Quantities that depend on growth and how they are connected

# What depends on what

see Methot and Wetzel 2013 tech doc for details



# What depends on what

see Methot and Wetzel 2013 tech doc for details

