## Biomass estimation and dynamics (8.5 A&IFFD P353) [Mike]

### Direct methods (N x mean w) (8.5 A&IFFD P357)

asd

### Estimates from fishery catch (8.5 A&IFFD P353)

asdf

### Modeling approaches-mass balance of Ecopath equations

Asdf

Instantaneous rates

One of the major differences you will run into when comparing fisheries to any terrestrial counterpart is the use of instantaneous rates. Instantaneous rates are applied over very small time increments (i.e., dt 🡪0). The differences between instantaneous and finite rates is further complicated by the fact that as both types of rates approach 0 they become more and more similar in value. **Finite rates are what you are most likely used to, like the population decreased 30% from one year to the next.** Rates can be converted from instantaneous to finite and back again using the equations below. In the example above the intrinsic instantaneous growth rate was 0.3.

Instantaneous rates can be converted to finites rates using the equation and example below.



To convert the finite rate back to an instantaneous rate simply use the equation:



Let’s explore this property and consequences to get a better feel for the subtle but important difference between instantaneous and finite rates and why using the right one is important with the following exercise. Using the model you built in exercise 1 perform the following steps (Note. Feel free to reference the video tutorial to do any of the steps and recall the intrinsic growth rate was 0.3 and the initial abundance was 10):

1) Open the run specs for the model (Run🡪 Run Specs or ALT+CTL+R) and make sure that the *dt* is set to 0.01 and the years to run is set to 10, and press OK.

2) Be sure to set *intrinsic growth rate* = 0.3 and press CTL+R to run the model and record the biomass at the end of the simulation. This will be the last row in the data pad in STELLA.

Abundance (t = 1): \_\_\_\_\_\_\_\_\_\_

Abundance (t = 5): \_\_\_\_\_\_\_\_\_\_

Abundance (t = Final): \_\_\_\_\_\_\_\_\_\_

3) Repeat steps 1 and 2 but set *dt* to 1 and record the following from the data pad.

Abundance (t = 1): \_\_\_\_\_\_\_\_\_\_

Abundance (t = 5): \_\_\_\_\_\_\_\_\_\_

Abundance (t = Final): \_\_\_\_\_\_\_\_\_\_

4) Now let’s see what happens when instantaneous and finite rates are treated appropriately by correctly applying rate and . **Be sure to set *intrinsic finite growth rate* = 0.** **349859** **and press CTL+R** (*Recall you set dt to 1 in the previous exercise, do that here too!*) to run the model and record the following from the data pad.

Abundance (t = 1): \_\_\_\_\_\_\_\_\_\_

Abundance (t = 5): \_\_\_\_\_\_\_\_\_\_

Abundance (t = Final): \_\_\_\_\_\_\_\_\_\_

5) Save the model. File🡪 Save.

### Biomass dynamic models: surplus production models

#### Models

##### Exponential





##### Graham-Schaefer





##### Fox model





##### Pella-Tomlinson

 (Pella and Tomlinson 1969)



Theta-logistic (1973)



#### Reference points (e.g., FMSY, BMSY)

Analytical solutions

Simulation solutions

* Adding environmental noise lead to more conservative estimates of reference points for the PT and Fox (Bordet and Rivest 2014)
* ?? (Pedersen and Berg 2017)
* Multi species model (Dedah et al. 1999)
* Fox model (Fox 1970)
* (Hakanson and Boulion 2004)
* (Hakanson and Boulion 2003; Hakanson and Gyllenhammar 2005)
* (Laloe 1995)
* (Polacheck et al. 1993)
* (Prager 1994; Prager 2002; Williams and Prager 2002)
* (Randall 2002; Randall and Minns 2000)
* (Ricker 1946)
* (Waters and Huntsman 1986; Waters 1969; Waters 1992)
* (Zhang and Megrey 2010)

## Production estimation (8.7 A&IFFD P360)[tom]

### Concepts and terminology: a vital rate (8.7.1 A&IFFD P360)

### Production estimation methods (8.7.2 A&IFFD P361)

#### Summation methods (A&IFFD P362)

#### Instantaneous Growth Rate and Allen Curve methods (A&IFFD P363)

#### Size-Frequency Method (A&IFFD p366)

### Production to mean biomass (P/B) ratio (A&IFFD P367)

#### Direct estimates

#### Estimates based on life history and allometry

5.4.4 Production estimates in practice (A&IFFD P367)

5.5 Summary and practical considerations []

Assuming we just redo the boxes in R then these will come together quickly.

Box 1. Estimating biomass using direct methods

Box 2. Solving an ordinary differential equation

Box 1 Application of surplus production modeling (Box 8.7 A&IFFD P 358)[Code done; needs narrative]

Box 2. Production estimation based on the instantaneous growth rate method (Box 8.8 p364)[pending]

Box 3. Production estimation based on the Size-Frequency method (P368)[pending]

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