How to compare the traditional female age-specific life table and age-stage, two-sex life table

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First: Analyze your life table data by using the female age-specific life table

A. Including female individuals only.
B. Including female individuals and 50% individuals died in the preadult stages. Problem: If there are 3 or 5 dead in preadult stages, how many should you include in analysis?
C. Including female individuals and $x \times n_{total\ adults}$ individuals died in the preadult stages, where x is the proportion of female adults in total adults ($n_{total\ adults}$). Problem: You will face the problem that $x \times n_{total\ adults}$ is not an integer.

A. Including female individuals only

1. You can calculate the following statistics:
   a. Developmental time of each stage, the adult longevity
   b. The survival rate of each stage (the hatch rate of eggs, pupation rate, and adult emergence rate).
   c. The mean fecundity (F) of all female
   d. The preoviposition period (APOP and TPOP)
   e. The oviposition days

A. Including female individuals only

2. You can prepare following figures:
   a. Female age-specific survival rate (l_x)
   b. Female age-specific fecundity (m_x)
   c. Female age-specific net maternity ($l_x m_x$)

Problem:
   a. Should you ignore stage differentiation and calculate l_x and m_x based on age indexed from 0?
   b. Should you take stage differentiation into consideration and calculate l_x and m_x based on adult age? But how?
   c. How can you detect the proportion of female offspring? If you assume 1:1 sex ratio, what should you do if there are 13 eggs laid at age x?

A. Including female individuals only

3. You can calculate the population parameters:
   a. Intrinsic rate of increase (r)
   b. Finite rate of increase (λ)
   c. Net reproductive rate (R_0)
   d. Mean generation time (T)

Problems: Your results are affected by the assumptions and problems.

A. Including female individuals only

4. You can calculate the e_x and v_x.
   All individuals at the same age have the same e_x and v_x.
   Problems: Your results are affected by the assumptions and problems.

A. Including female individuals only

5. Population projection

There will be a single line: total population size.

Problems: Your results are affected by the assumptions and problems. If you use "adult age", you will get erroneous simulation results.

B. Including female individuals and 50% individuals died in the preadult stages. Problem: If there are 3 or 5 dead in preadult stages, how many should you include in analysis?

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C. Including female individuals and $x \times n_{total\ adults}$ individuals died in the preadult stages, where x is the proportion of female adults in total adults ($n_{total\ adults}$). Problem: You will face the problem that $x \times n_{total\ adults}$ is not an integer.

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5. Population projection
   There will be a single line: total population size.
   Problems: Your results are affected by the assumptions and problems. If you use "adult age", you will get erroneous simulation results.

The age-stage, two-sex life table

Including all individuals (female, male and those died in the preadult stages).

The age-stage, two-sex life table

1. You can calculate the following statistics:
   a. Developmental time of each stage, the adult longevity
   b. The survival rate of each stage (the hatch rate of eggs, pupation rate, and adult emergence rate).
   c. The mean fecundity (F) of all female
   d. The preoviposition period (APOP and TPOP)
   e. The oviposition days

The age-stage, two-sex life table

2. You can prepare following figures:
   a. Age-stage specific survival rate (s_{xj})
   b. Age-specific survival rate (l_x)
   c. Age-stage specific fecundity (f_{xj}) (usually only one $f_{x,female}$ curve)
   d. Age-specific fecundity (m_x)
   e. Age-specific net maternity ($l_x m_x$)

Problem: None.

The age-stage, two-sex life table

3. You can calculate the population parameters:
   a. Intrinsic rate of increase (r)
   b. Finite rate of increase (λ)
   c. Net reproductive rate (R_0)
   d. Mean generation time (T)

Problems: None.

The age-stage, two-sex life table

4. You can calculate the e_x and v_x.
   Individuals at the same age but in different stage may have different e_x and v_x. You can detect the difference between female and male
   a. Age-stage specific life expectancy (e_{xj})
   b. Age-specific life expectancy (e_x)
   c. Age-stage specific reproductive value (v_{xj})
   d. Age-specific reproductive value (v_x)

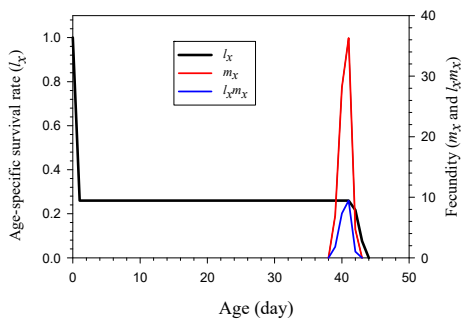
Problems: None.

The age-stage, two-sex life table

5. Population projection
   The change of stage structure can be observed.
   The stage growth rate can be calculated.
   The male population can be observed.

Problems: None.

Female age-specific life table



Age-stage, two-sex life table

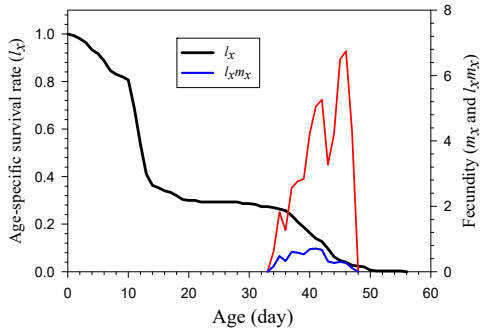


Table 1. Mean (±SE) of developmental time

Stage	Age-stage, two-sex life table			Female age-specific life table
	Female	Male	N-type	Female
Egg	(♀ eggs)	(♂ eggs)	(N-type eggs)	(♀ eggs)
Larva	(♀ larvae)	(♂ larvae)	(N-type larvae)	(♀ larvae)
Pupa	(♀ pupae)	(♂ pupae)	(N-type pupae)	(♀ pupae)
Adult	(♀ adults)	(♂ adults)	-	(♀ adults)

Table 2. Mean (±SE) of hatch rate, pupation rate, and adult emergence rate

Statistics	Age-stage, two-sex life table				Female age-specific life table
	Female	Male	N-type	All	Female
Egg hatch rate	1 (♀)	1 (♂)	(N-type)	0.8	(♀ eggs?)
Larva survival rate	1 (♀)	1 (♂)	(N-type)	0.6	(♀ eggs?)
Preadult survival rate (s_a)	1 (♀)	1 (♂)	(N-type)	0.48	(♀ eggs?)

Table 3. Mean (±SE) of APOP, TPOP, fecundity, and oviposition days

Stage	Age-stage, two-sex life table			Female age-specific life table
APOP	(all eggs/female)			(female eggs?)
APOP	♀ eggs	♂ eggs	N-type eggs	-
TPOP	(all eggs)			(female eggs?)
TPOP	♀ eggs	♂ eggs	N-type eggs	-
Fecundity	(all eggs)			(female eggs?)
Fecundity	♀ eggs	♂ eggs	N-type eggs	-
Oviposition days	(all eggs)			(female eggs?)
Oviposition days	♀ eggs	♂ eggs	N-type eggs	

Table 3. Mean (±SE) of population parameters

Stage	Age-stage, two-sex life table	Female age-specific life table
r	(all individuals)	(female eggs?)
λ	(all individuals)	(female eggs?)
R_0	(all individuals)	(female eggs?)
T	(all individuals)	(female eggs?)

There will be always errors!

- You will always get erroneous results, if you use the traditional female age-specific life table.
- You cannot predict the population growth, if you use the traditional female age-specific life table.
- You cannot do IPM, biological control, or any ecological management, if you use the traditional female age-specific life table.
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