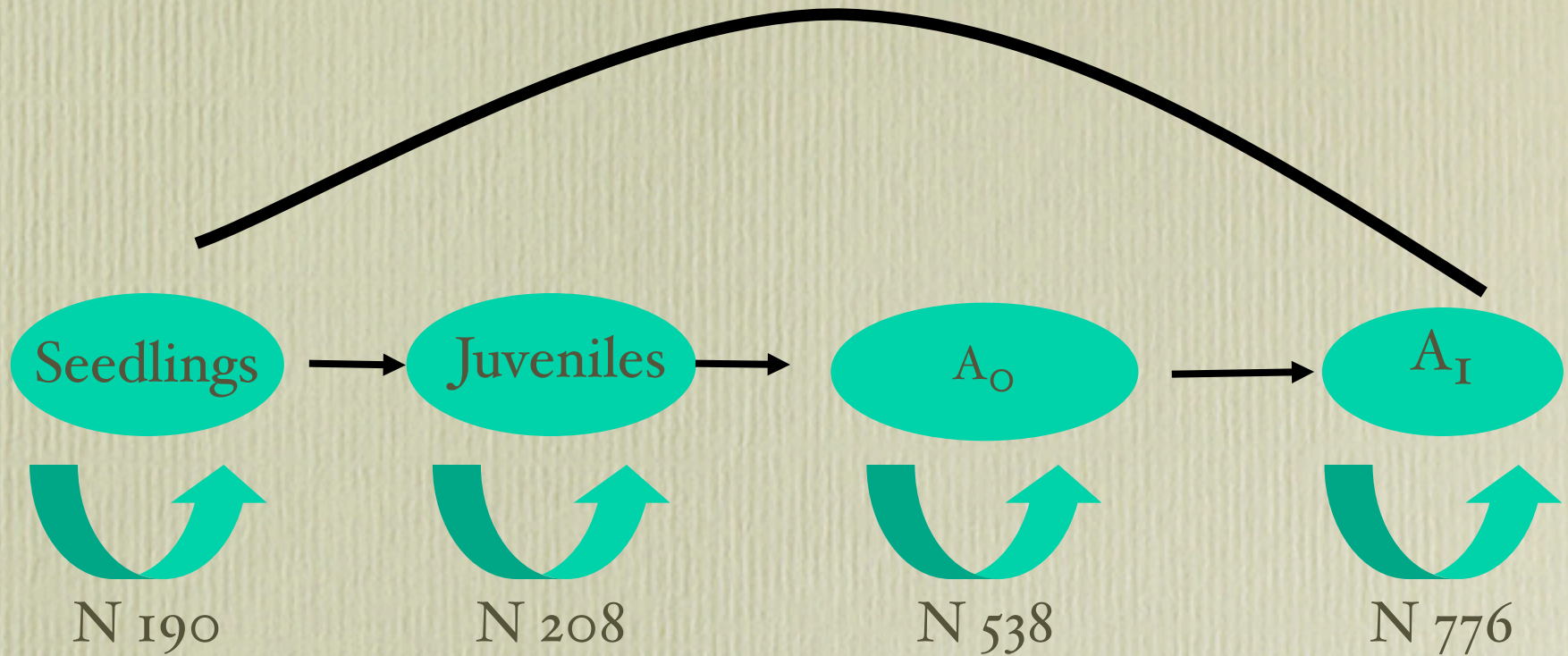
Life history diagram and methodology

- *Plantis perrenialis*
  - N = 228
  - Sept 1994 – Sept 1995
  - Year survey



Life-history diagram of *Plantis perrenialis*

t-1

t

	Seedling	Juvenile	A0	A+
S	**180**			
J	**4**	**197**		
A0			**354**	**142**
A+		**11**	**181**	**633**
Dead	**6**		**3**	**1**
Total	**190**	**208**	**538**	**776**

What's the proportion of seedlings that grow to the juvenile stage?

t-1

t	Seedling	Juvenile	A0	A+
S	180			
J	4			
A0				
A+				
Dead	6			
Total	190	208	338	776

180/190 = 0.9474

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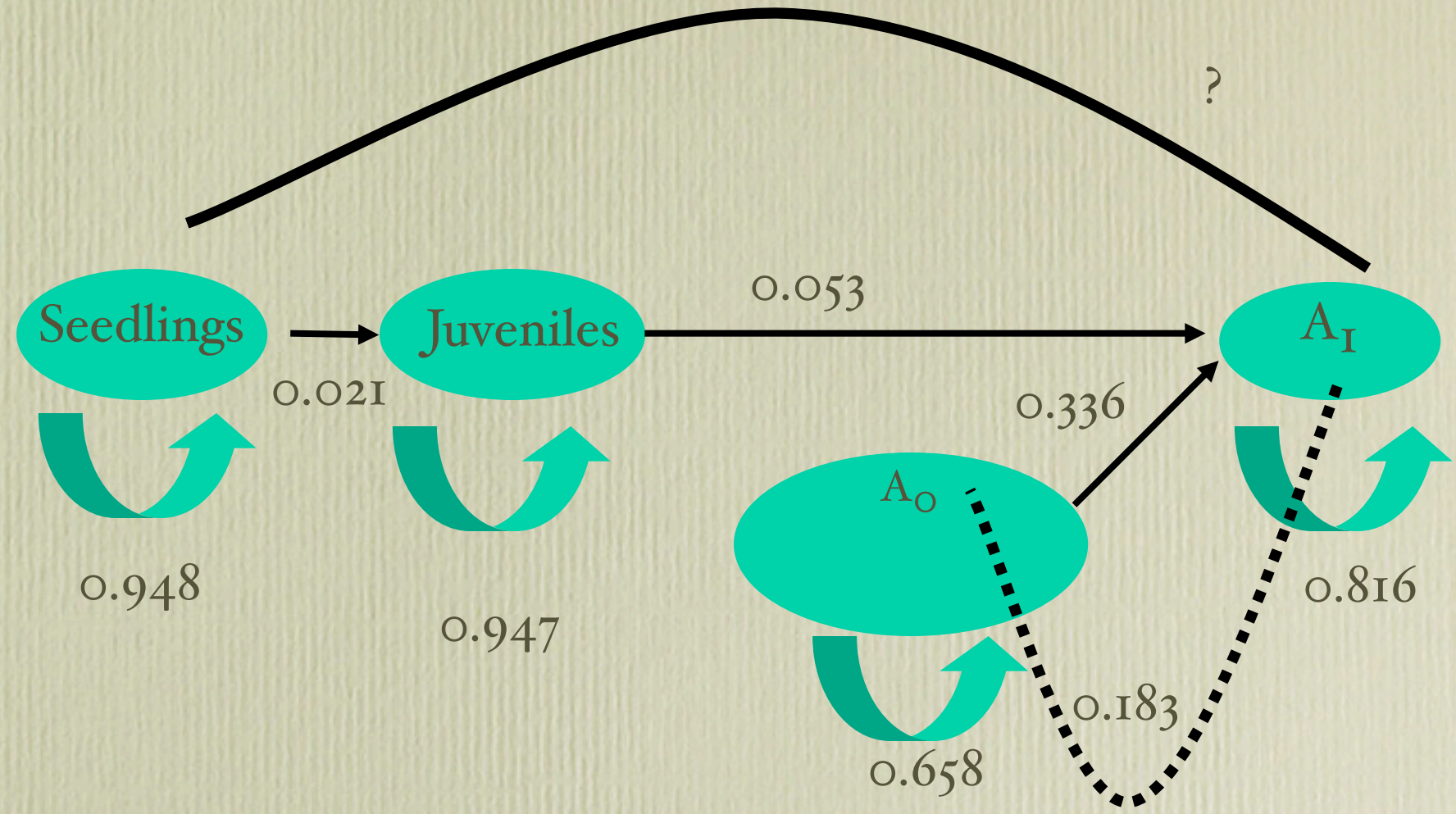
t-1

t

	Seedling	Juvenile	A0	A+
S	0.9474			
J	0.0211	0.9471		
A0			0.6580	0.1830
A+		0.0529	0.3364	0.8157

Where are the dead plants?



Population growth rate of *Lepanthes eltoroensis*

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The data in matrix form

t	t-1 Stage (S)	Stage (J)	Stage (Ao)	Stage (A+)
Stage (S)	0.9474	0	0	?
Stage (J)	0.0211	0.9471	0	0
Stage (Ao)	0	0	0.6580	0.1830
Stage (A+)	0	0.0529	0.3364	0.8157

Individuals that remain within the same stage as in t-1

t-1

t	Stage (S)	Stage (J)	Stage (Ao)	Stage (A+)
Stage (S)	0.9474	0	0	?
Stage (J)	0.0211	0.9471	0	0
Stage (Ao)	0	0	0.6580	0.1830
Stage (A+)	0	0.0529	0.3364	0.8157

Individuals that grow in comparison to t-1

t \ t-1	Stage (S)	Stage (J)	Stage (Ao)	Stage (A+)
Stage (S)	0.9474	0	0	?
Stage (J)	0.0211	0.9471	0	0
Stage (Ao)	0	0	0.6580	0.1830
Stage (A+)	0	0.0529	0.3364	0.8157

Individuals that decrease in size at t in comparison to t-1

t-1

t	Stage (S)	Stage (J)	Stage (Ao)	Stage (A+)
Stage (S)	0.9474	0	0	?
Stage (J)	0.0211	0.9471	0	0
Stage (Ao)	0	0	0.6580	0.1830
Stage (A+)	0	0.0529	0.3364	0.8157

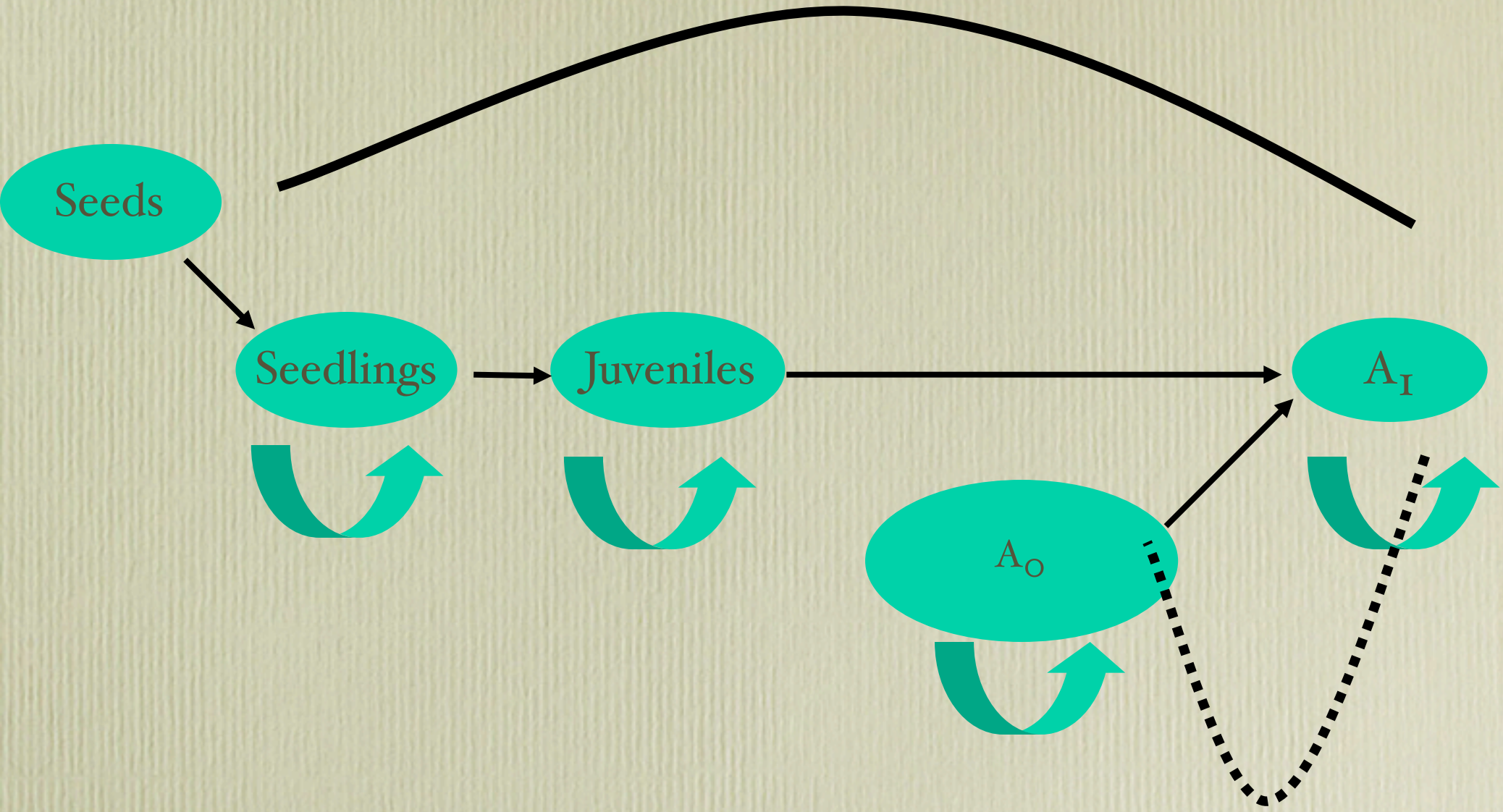
What happened with the reproduction?

- Consider that there were 18 reproductive individuals in the population during the sampling period.
- All individuals were produced by adults in stage 4 (reproductive adults).
- So, 18 individuals were produced by 776 adults at time t.
- F_{41}=18/776 =0.0039;
  where F_{41} is the fecundity of individuals at stage 4, which contribute to stage 1.

The complete matrix

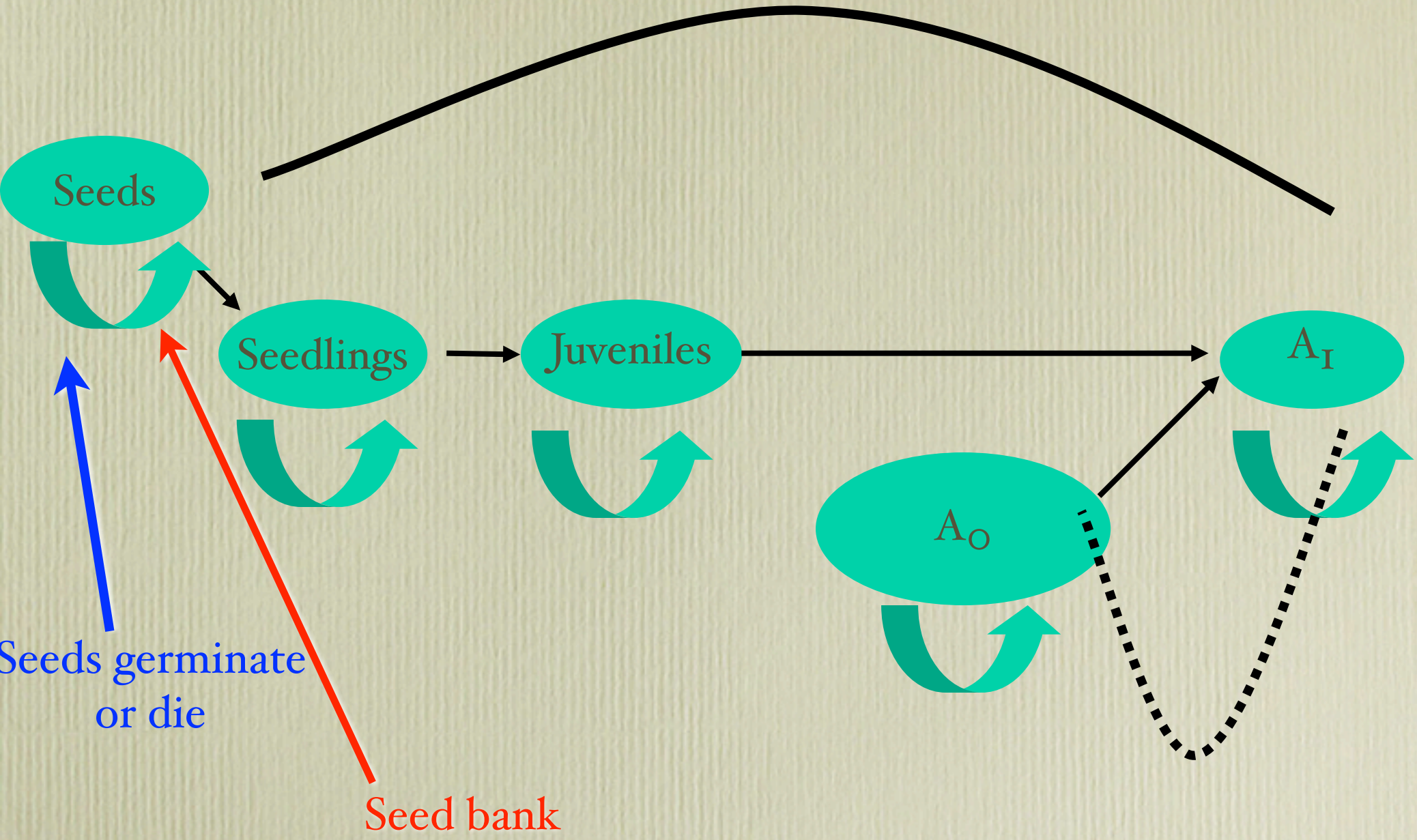
$$\begin{vmatrix} 0.9474 & 0 & 0 & 0.0039 \\ 0.0211 & 0.9471 & 0 & 0 \\ 0 & 0 & 0.6580 & 0.1830 \\ 0 & 0.0529 & 0.3364 & 0.8157 \end{vmatrix}$$

Consider a species with a seed-stage identifiable in the field


Seeds
Seedlings
Juveniles
A_I
A_O

Why zero?

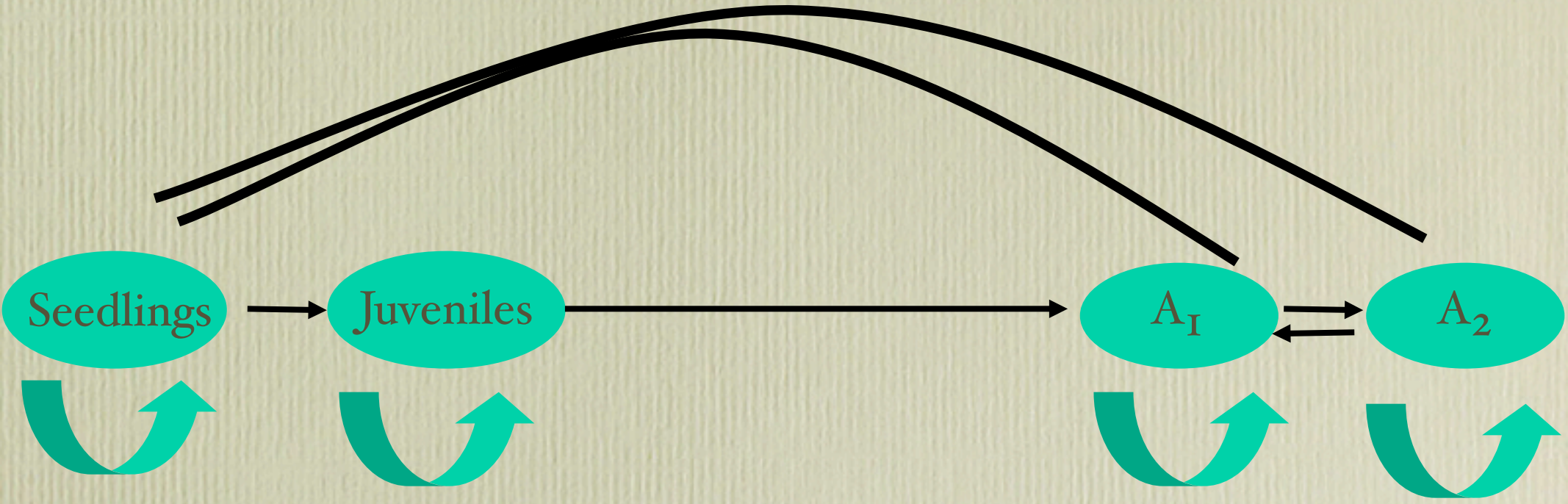
$$\begin{pmatrix} 0 & 0 & 0 & 0 & 10^6 \\ 0.0001 & 0.947 & 0 & 0 & 0 \\ 0 & 0.021 & 0.947 & 0 & 0 \\ 0 & 0 & 0 & 0.658 & 0.183 \\ 0 & 0 & 0.053 & 0.336 & 0.816 \end{pmatrix}$$


Seeds
Seedlings
Juveniles
A_I
A_O
Seeds germinate
or die
Seed bank

Proportion of seeds that stay alive on the ground

o.xxx	0	0	0	10^6
0.0001	0.947	0	0	0
0	0.021	0.947	0	0
0	0	0	0.658	0.183
0	0	0.053	0.336	0.816

Adding an adult stage



$$\begin{vmatrix} 0.947 & 0 & 0 & 0.004 & 0.011 \\ 0.021 & 0.947 & 0 & 0 & 0 \\ 0 & 0 & 0.658 & 0.183 & 0.050 \\ 0 & 0.052 & 0.133 & 0.815 & 0.110 \\ 0 & 0 & 0 & 0.200 & 0.852 \end{vmatrix}$$

Application of transition matrix models in forest dynamics: *Araucaria* in Papua New guinea and *Nothofagus* in New Zealand

Neal Enright & John Ogden

Australian Journal of Ecology, 1979, 4:3-23

Basic Methodology

-Data collected from two yrs in 1.5ha of lower montane forest (1,400m asl), near Bulolo, Papua and New Guinea.
All trees more than 2cm dbh in the plot were numbered and tagged in 1975 and remeasured the next yr.

-Two seedling plots 20m x 20m were used to asses the number of individuals in classes less then 2cm dbh. These were numbered and tagged, by measuring their height and noting the growth among the two years.

-Seed production ranged from 13,000 to 31,000, with a mean of 24,000 (estimated from cone counts).

-Trees reach maturity at c. 120 yrs (35cm dbh) and a maximum age of c.a. 400 yrs at 140cm dbh.

Height	Seeds	0-20 cm	20-100 cm	100-300 cm
No. of individuals	1,150,595	22,912	929	324
Survival	0.01646	0.0512	0.9511	0.9838
Proportion moving to next class	1	0.2381	0.0315	0.0184
Proportion remaining	0	0.7619	0.9685	0.9816

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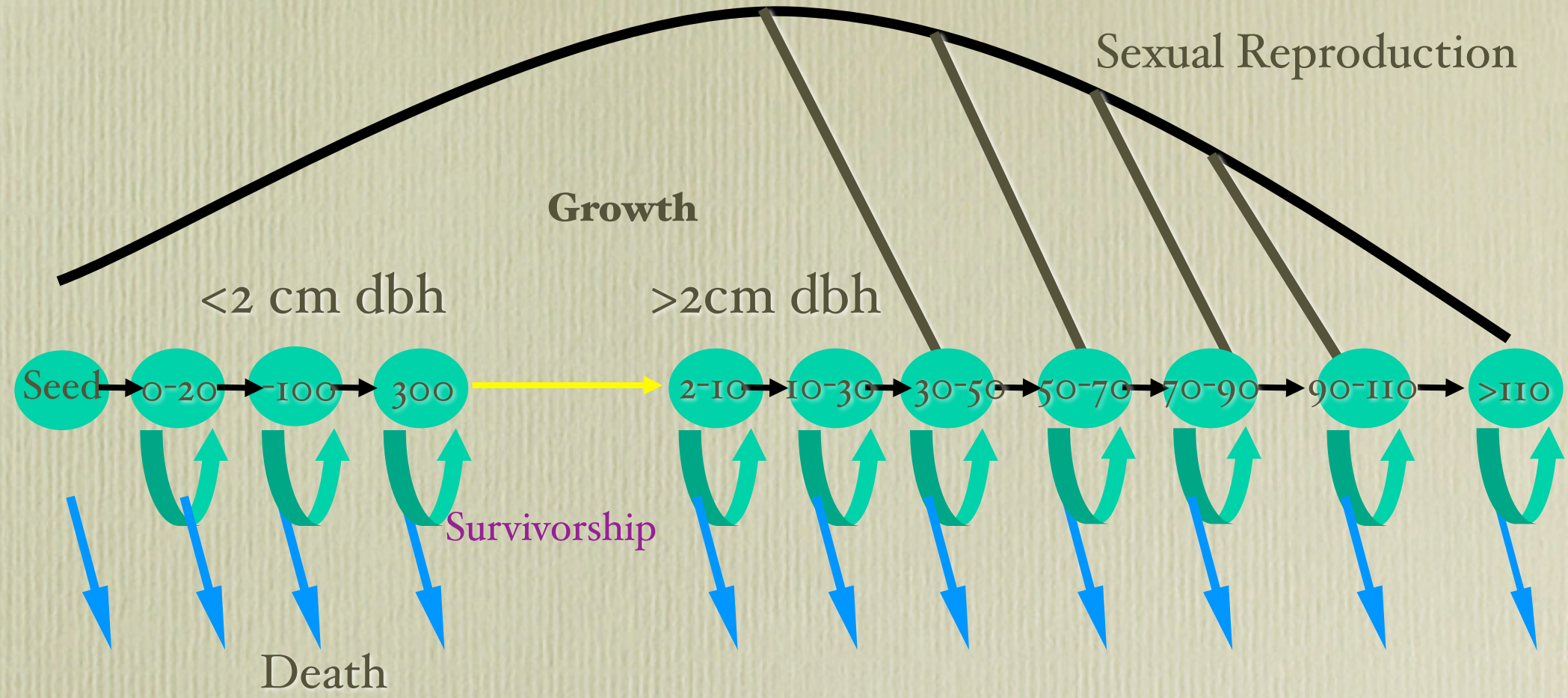
cm (dbh)	2-10	10-30	30-50	50-70	70-90	90-110	>110
No. individuals	222	48	13	11	21	6	5
Survivorship	0.9432	0.9822	0.9983	0.9948	0.9917	0.9954	0.9722
Proportion that grows class(*i*) to class(*j*)	0.0313	0.0139	0.0167	0.0124	0.0079	0.0118	0
Proportion remaining	0.9687	0.9861	0.9833	0.9876	0.9921	0.9882	1



Stage-based approach for

Auracaria cunninghamii

Seeds produced by each class

Staying in the same class

0	0	0	0	0	0	13356	30952	21111	19269	15510
.16	.039	0	0	0	0	0	0	0	0	0
0	.012	.921	0	0	0	0	0	0	0	0
0	0	.029	.966	0	0	0	0	0	0	0
0	0	0	.018	.914	0	0	0	0	0	0
0	0	0	0	.029	.969	0	0	0	0	0
0	0	0	0	0	.014	.977	0	0	0	0
0	0	0	0	0	0	.017	.983	0	0	0
0	0	0	0	0	0	0	.012	.984	0	0
0	0	0	0	0	0	0	0	.008	.984	0
0	0	0	0	0	0	0	0	0	.012	.972

Growing into the next class

$\lambda = 1.0204$

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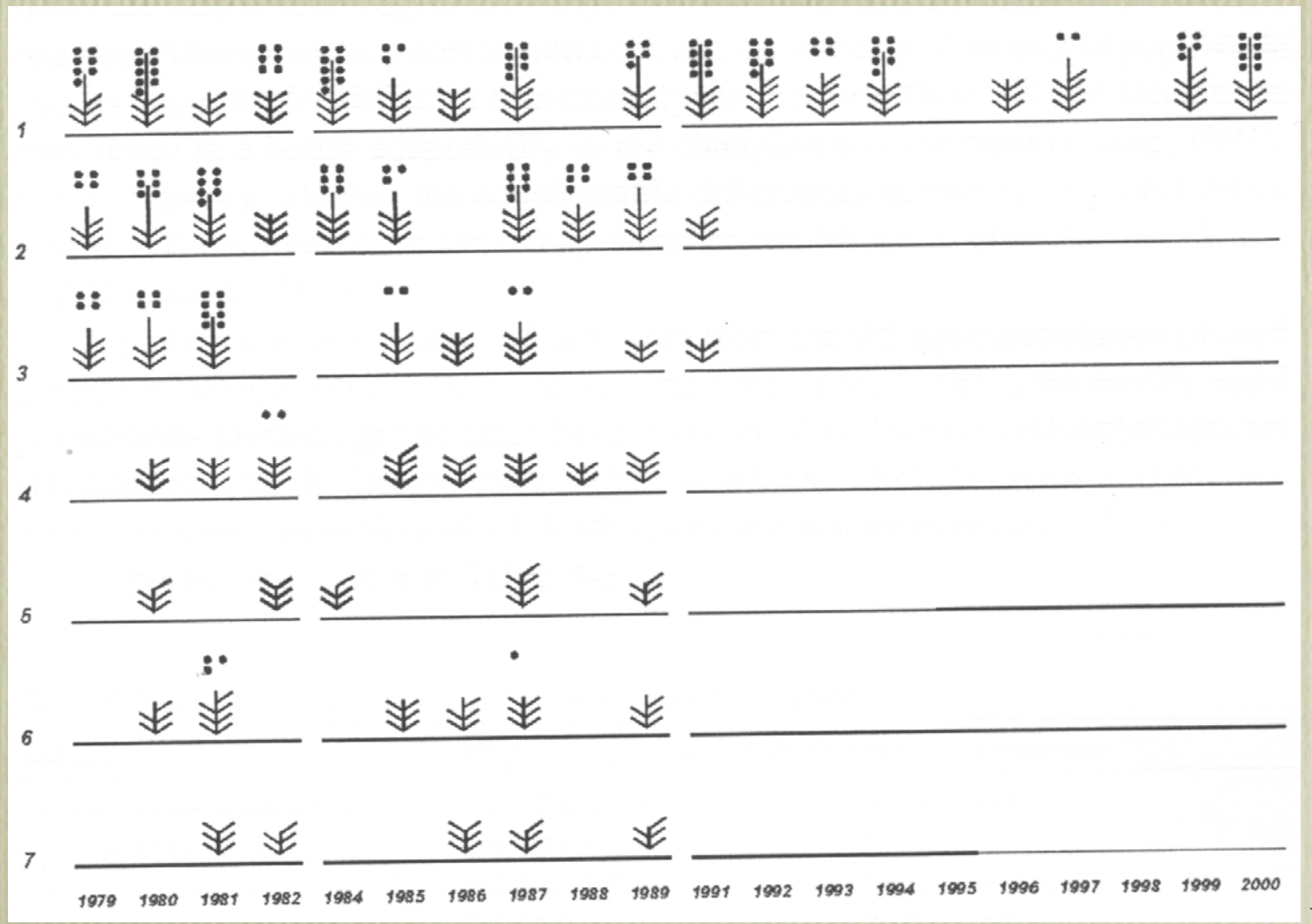
How to deal with inconspicuous stages?

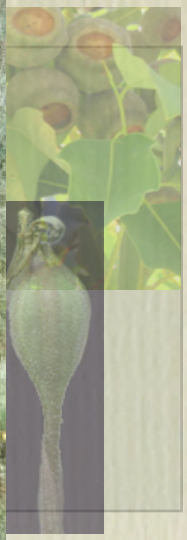
Latency in plants



Cephalanthera rubra

1979-2000

Mike Hutchings,
University of Sussex



A terrestrial example

Prasophyllum correctum

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Data from Fiona Coates, DSE, Melbourne, Victoria, Australia.

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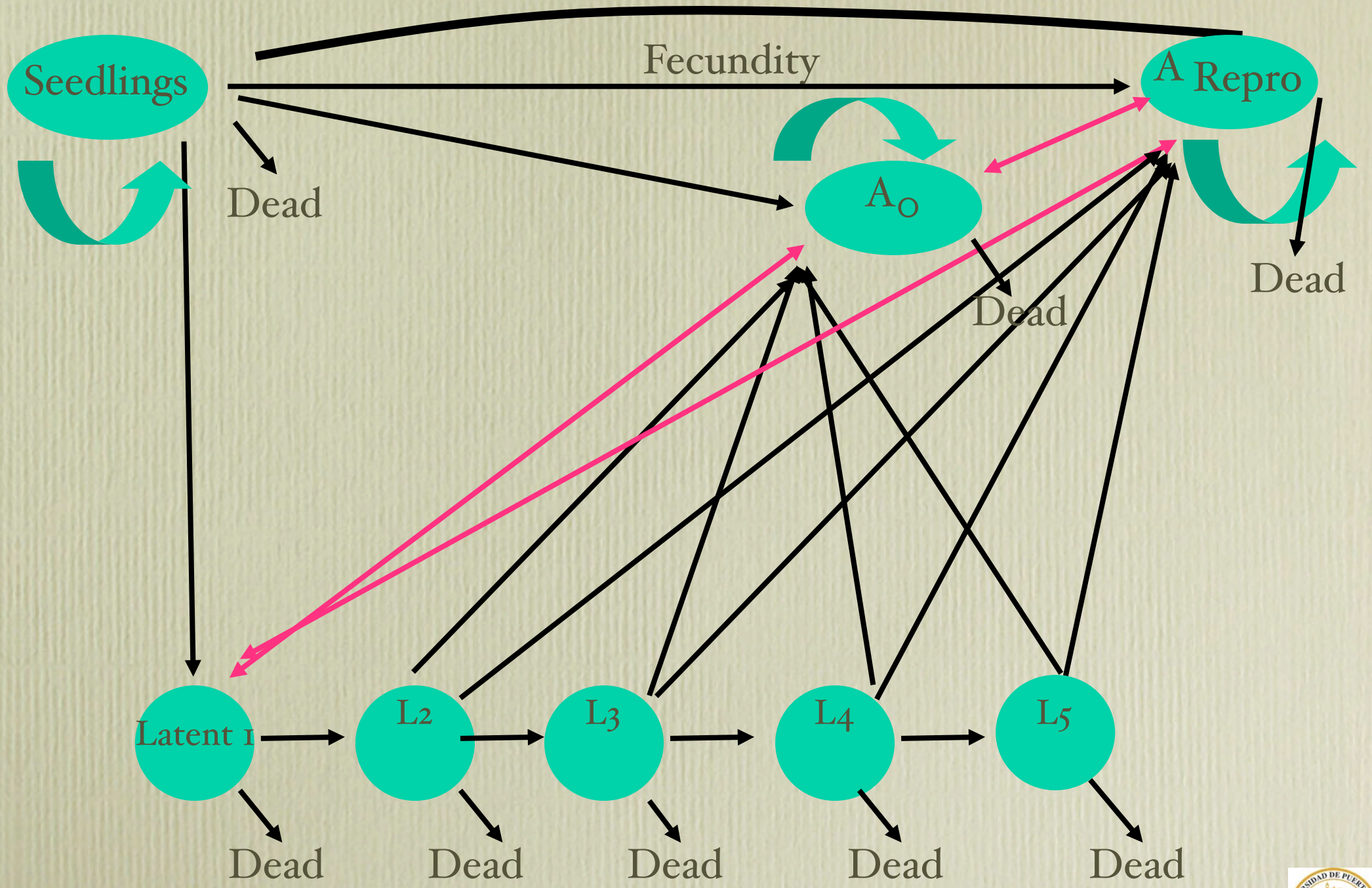
Life-history diagram of *Prasophyllum correctum*



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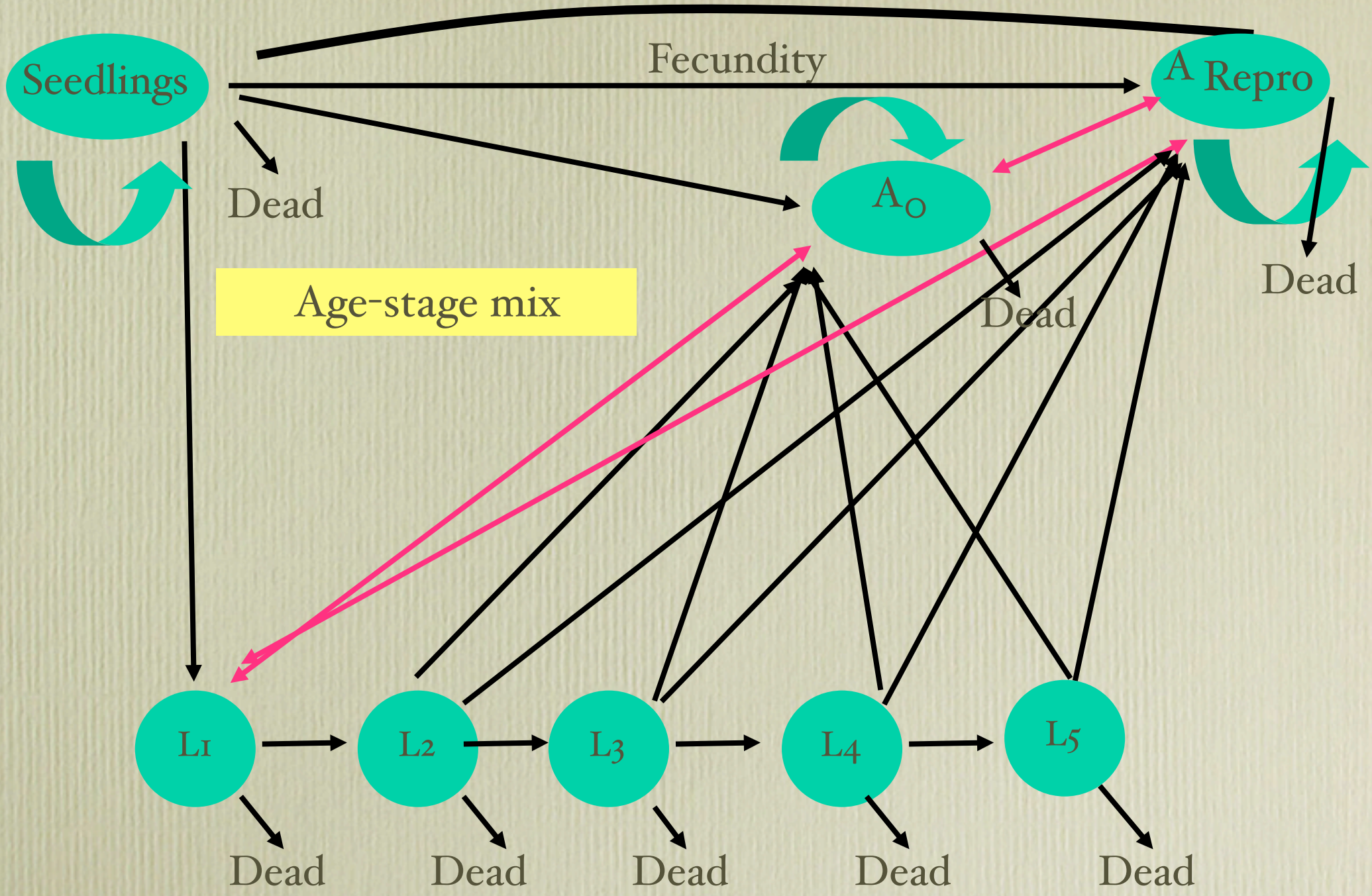

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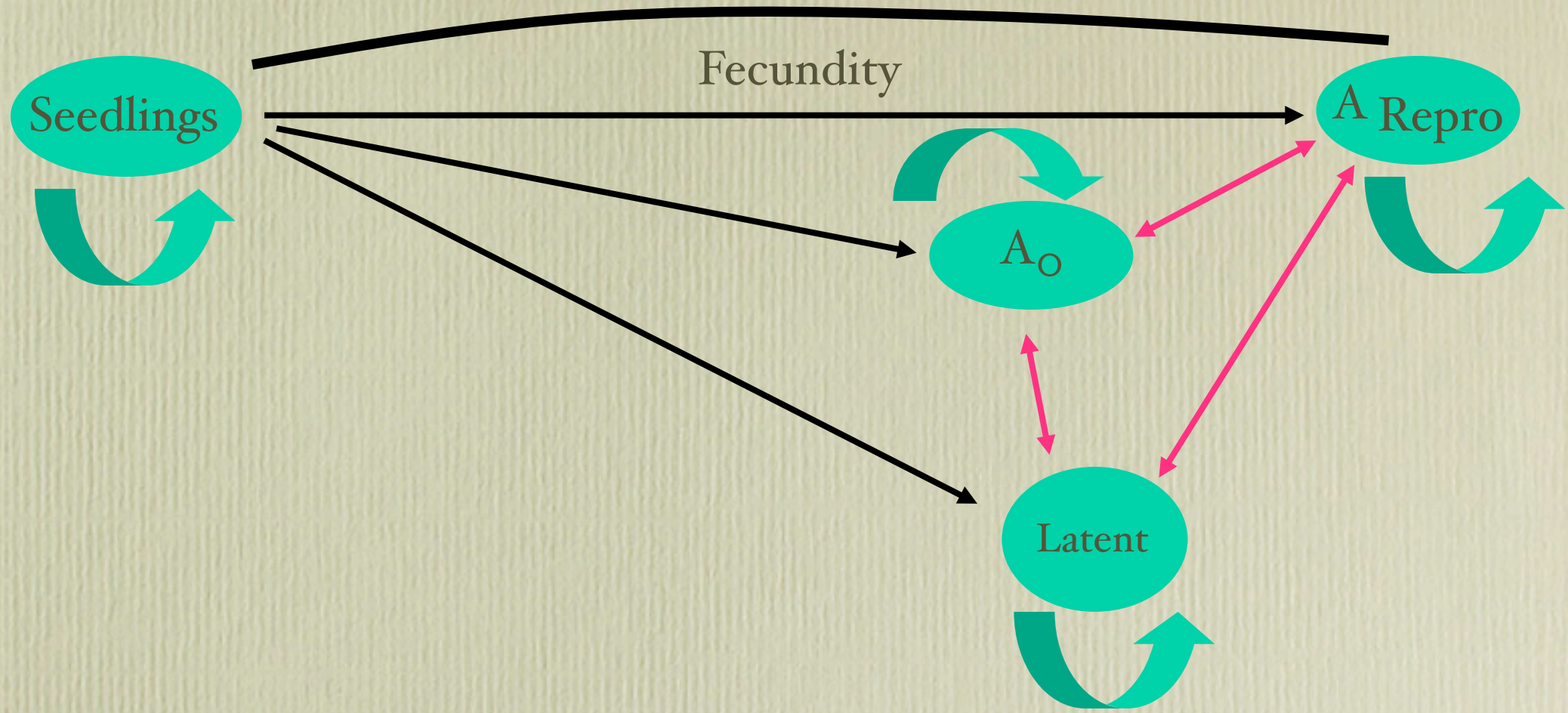

Life-history diagram of

Prasophyllum correctum

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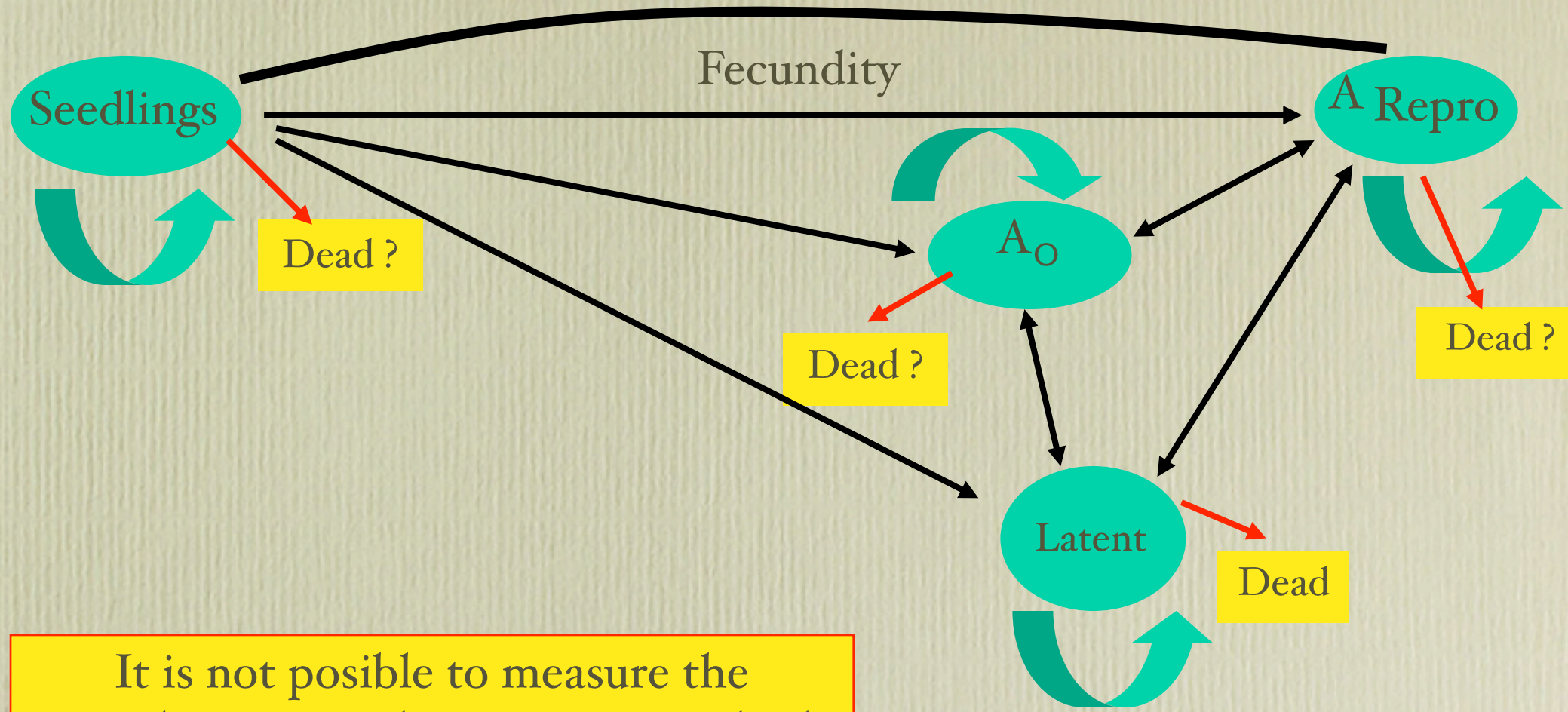

It is not posible to measure the mortality rates unless invasive methods are employed

Life-history diagram of

Prasophyllum correctum

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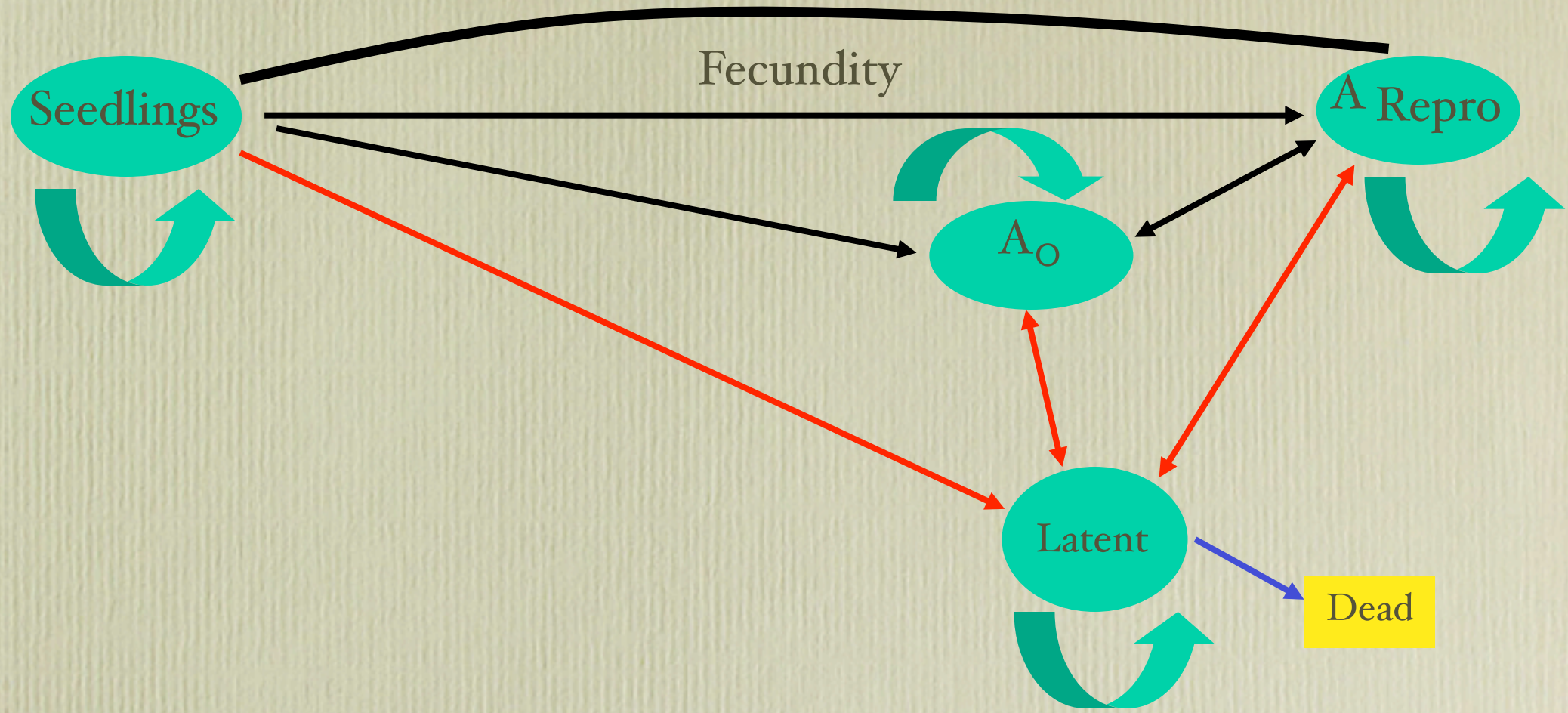

Life-history diagram of

Prasophyllum correctum

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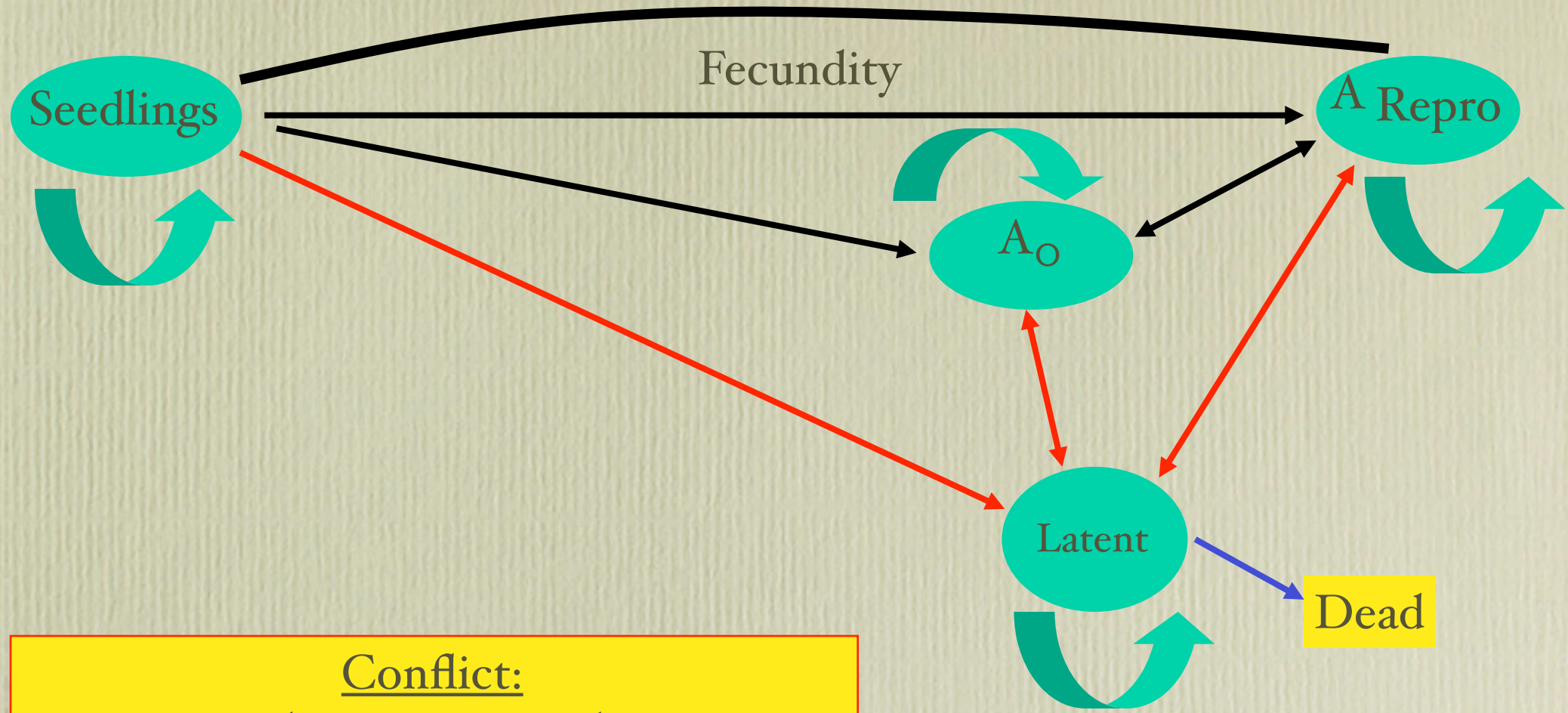

Conflict:
Reality vs. Practicality

Life-history diagram of

Prasophyllum correctum

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Life Table: *Prasophyllum correctum*

	Seedling	Sterile Adult	Dormant	Fertile Adult
Seedling	**0**	**0**	**0**	**0**
Sterile A	**0**	**0.3067**	**0.1645**	**0.1866**
Dormant	**.9999**	**0.5556**	**0.6867**	**0.5448**
Fertile A	**0**	**0.1378**	**0.0789**	**0.2687**

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