

## Supplementary material

### Appendix 1a. RAMAS/Metapop 4.0. Input data

Age structure: seven age classes (1 yr-olds, 2 yr-olds, 3 yr-olds, 4 yr-olds, 5 yr-olds, 6 yr-olds, and  $\geq 7$  yr-olds).

Mating system: polygynous, males allowed to mate with up to 3 females.

Initial abundances: 61 for retrospective models and 150 for management scenarios. Density-dependence: a ceiling model was used that affected all vital rates and based on the abundance of all stages.

Initial carrying capacity ( $K$ ): 180 for retrospective models (Denton and Beebee 1993) and 250 for management scenarios.

Environmental stochasticity: modelled by drawing values randomly from lognormal distributions.

Catastrophe: pond desiccation risk of 0.14, reducing recruitment by 20%.

## Appendix 1b. RAMAS/Metapop 4.0. Stage and standard deviation matrices

See text and Appendix 1a for justification of values for stage matrix; standard deviations for survival rates in age classes 1 and 2 were calculated from the maximum and minimum number of eggs per spawn string laid by female in the site (Banks and Beebee 1986) while standard deviations for survival of adults were obtained from Banks et al. (1993).

Stage matrix

		Females							Males						
		1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	≥7 yr	1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	≥7 yr
F e m a l e s	1 yr	0.0	0.0	11.5	11.5	11.5	11.5	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2 yr	0.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3 yr	0.0	0.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4 yr	0.0	0.0	0.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5 yr	0.0	0.0	0.0	0.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6 yr	0.0	0.0	0.0	0.0	0.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	≥7 yr	0.0	0.0	0.0	0.0	0.0	0.85	0.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M a l e s	1 yr	0.0	0.0	11.5	11.5	11.5	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.0	0.0	0.0	0.0	0.0	0.0
	3 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.0	0.0	0.0	0.0	0.0
	4 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.47	0.0	0.0	0.0	0.0
	5 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.47	0.0	0.0	0.0
	6 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.47	0.0	0.0
	≥7 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.47	0.0

Standard deviation matrix

		Females							Males						
		1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	≥7 yr	1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	≥7 yr
F e m a l e s	1 yr	0.0	0.0	4.0	4.0	4.0	4.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2 yr	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3 yr	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4 yr	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5 yr	0.0	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6 yr	0.0	0.0	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	≥7 yr	0.0	0.0	0.0	0.0	0.0	0.05	0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M a l e s	1 yr	0.0	0.0	4.0	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	3 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	4 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.0	0.0	0.0	0.0
	5 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.0	0.0	0.0
	6 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.0	0.0
	≥7 yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.15	0.0