

Supporting Information

Demographic consequences of changing environmental periodicity, *Ecology*

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Appendix S1 - Detailed life cycles and vital rates taken into account for the three study species.

Marmot life cycle and vital rates

For the marmot population, we considered the following life-history stages: juvenile (J), yearling (Y), reproductive adult (R), and non-reproductive adult (N) (Fig. S1). The vital rates we took into account were seasonal stage-specific survival (σ ; binary variable 0 or 1); yearling, non-reproductive or reproductive adult individual probability of reproducing, that is, winter to summer transition to or stasis in the reproductive stage (ϕ_Y , ϕ_N , and ϕ_R ; binary variable 0 or 1); and recruitment (recruits; number of juveniles emerging from burrows per individual). Since we incorporated only females into our demographic model, we divided the number of recruits by two, assuming an even sex ratio among recruits (Armitage and Downhower 1974).

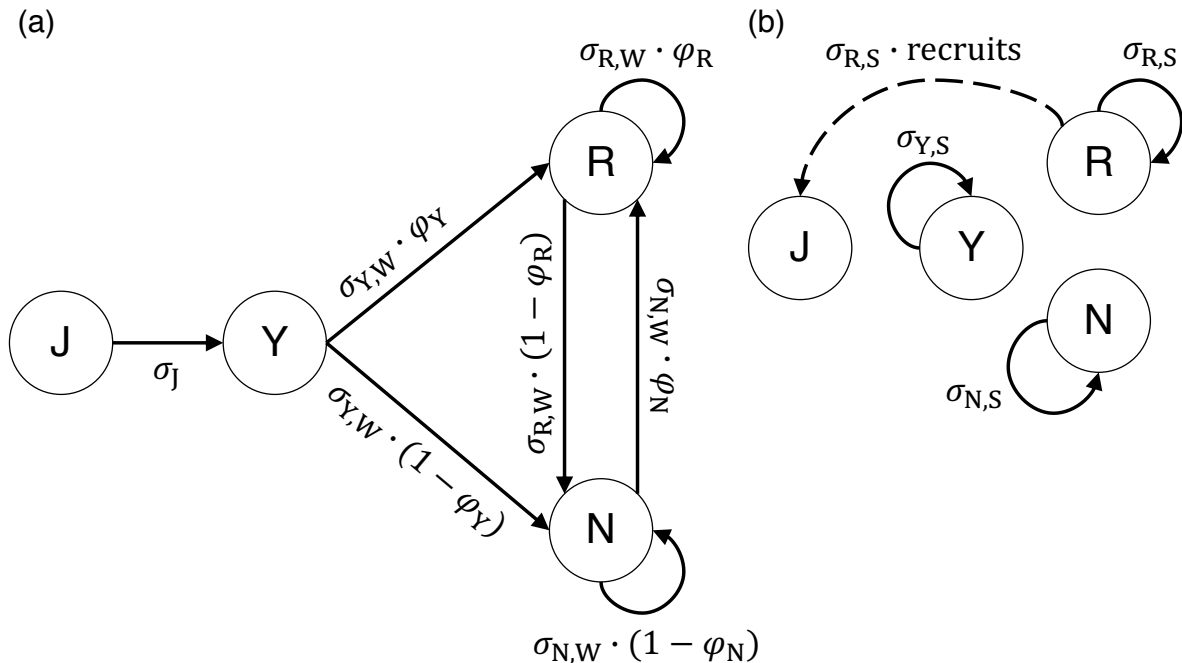


Figure S1 – Marmot (*Marmota flaviventer*) seasonal life cycle. The population has been divided into four stages: juvenile (J; 0–1 year of age), yearling (Y; 1–2 years), non-reproductive adult (N; >2 years and not observed to reproduce), and reproductive adult (R; >2 years and observed to reproduce). Stage transitions and reproduction are indicated by solid and dashed arrows, respectively. Stage transitions over (a) winter (August to June, subscript W) and (b) summer (June to August, subscript S) are conditional on survival (σ). Individuals in all stages but J can become reproductive with a probability ϕ or non-reproductive with a probability $1-\phi$. In summer, the reproductive output is determined by the average number of recruits per individual (recruits).

Meerkat life cycle and vital rates

The life cycle consists of the following stages: juvenile (J), subadult (S), helper (H), and dominant (D), linked by six-month transitions (Fig. S2). The vital rates we took into account were seasonal, stage-specific survival (σ ; binary variable 0 or 1), helper emigration (ε ; binary variable 0 or 1), helper transition to dominant (ϕ ; binary variable 0 or 1), and recruitment (recruits_H and recruits_D ; number of surviving pups by females for helpers and dominants).

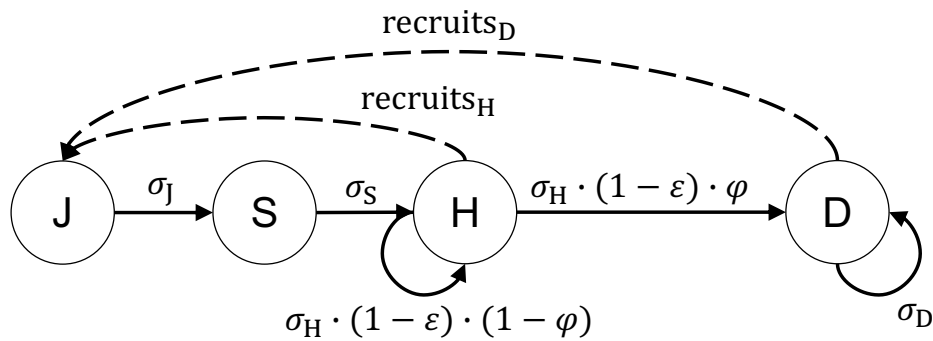


Figure S2 – Meerkat (*Suricata suricatta*) life cycle. The population has been divided into four stages: juvenile (J; 0–6 months of age), subadult (S; 6–12 months), helper (H; >12 months with a subordinate status), and dominant (D; >12 months with a dominant status). Solid arrows represent the six-month transitions between the four stages, conditional on survival (σ), emigration (ε), and transition to the dominant stage (φ). Dashed arrows represent the number of recruits for a helper (recruits_H) and dominant individual (recruits_D).

Dewy pine life cycle and vital rates

The life cycle of the dewy pine consists of yearly transitions depending on time since fire (TSF). The TSF-specific vital rates we took into account were seed bank-related variables (probability to stay in the seed bank staySB , to germinate from the seed bank outSB , to enter the seed bank goSB , or to directly germinate when produced goCont), and stage-specific survival (σ ; binary variable 0 or 1), transitions (φ ; binary variables 0 or 1), flowering probability (p_{fl} ; binary variable 0 or 1), and other reproduction-related variables (number of flowering stalks fls , number of flower per stalk fps , and number of seeds per flower spf ; count variables (for details, see Paniw et al. 2016)).

Right after a fire (TSF_0), all aboveground individuals die, and seeds germinate from (outSB) or remain in the seed bank (staySB) (Cross et al. 2017; Paniw, Quintana-Ascencio et al. 2017; Gómez-González et al. 2018; Fig. S3a). Seeds then either grow to seedling or juvenile sizes at TSF_1 (φ_S and φ_J ; Fig. S3b). During TSF_1 , individuals reach the adult size (small or large), conditional on survival (σ), and any remaining seeds in

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the seed bank grow to seedling sizes, as rapid growth to juvenile sizes has only been observed in TSF_0 . The second year after fire (TSF_2), the dewy pine reaches reproductive maturity (Fig. S3c). Reproductive individuals can grow, shrink, or stay in the same stage (conditional on the growing and shrinking probabilities φ_{SR} and φ_{LR} and on survival σ_{SR} and σ_{LR}). Reproductive individuals produce seeds that either enter the seed bank or germinate immediately in $t+1$ with probabilities given by the reproduction-related vital rates. Finally, in TSF_3 and $\text{TSF}_{>3}$ —the last post-fire state in which the population will stay until the next fire—life-cycle transitions resemble ones in TSF_2 but the demographic performance of aboveground individuals declines rapidly, as plants are outgrown by surrounding aboveground vegetation, and seed persistence in the seed bank increases (Paniw, Quintana-Ascencio et al. 2017; Paniw, Salguero-Gómez and Ojeda 2017).

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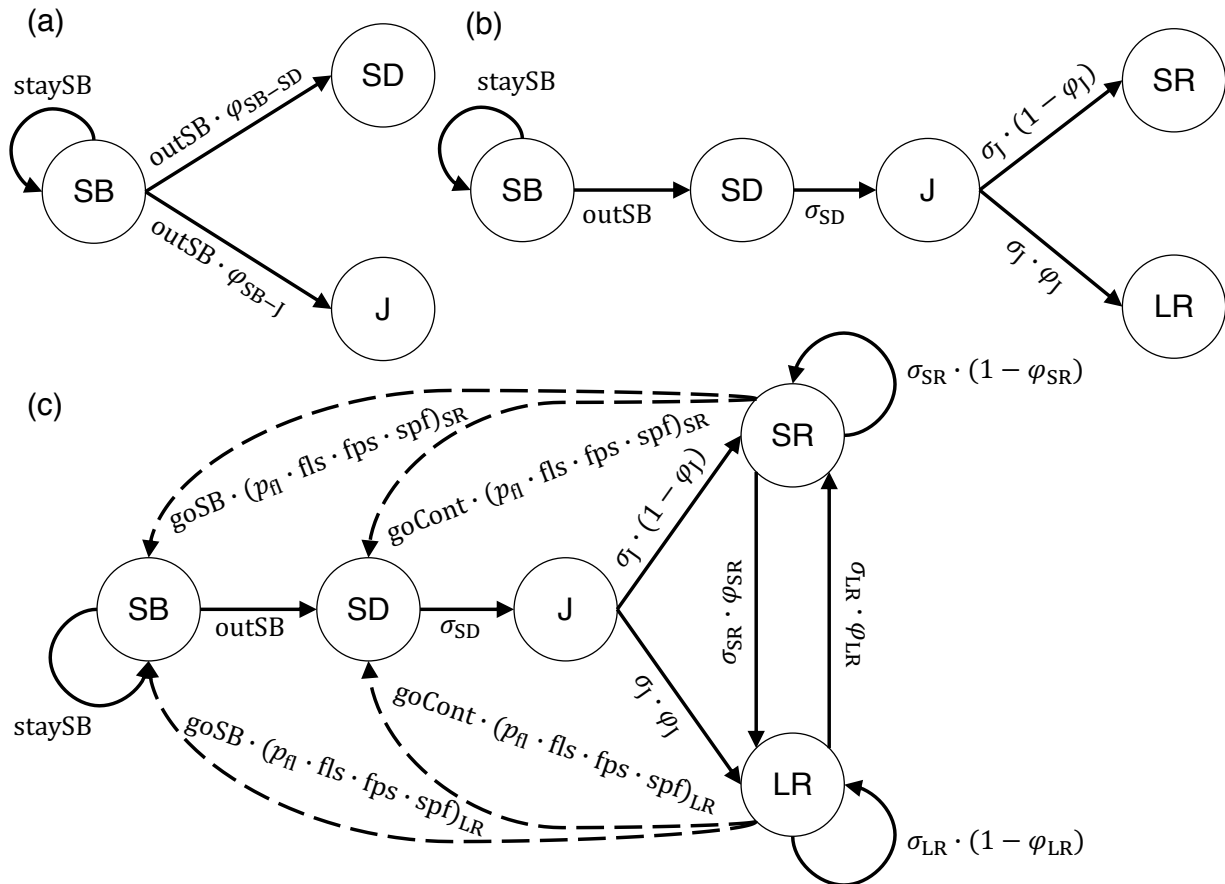


Figure S3 – Dewy pine (*Drosophyllum lusticanium*) periodic life cycle. The life cycle consists of one-year transitions and follows a succession of post-fire habitats determined by the time since last fire (TSF). The life-history stages are: seeds in the seed bank (SB), seedling (SD), juvenile (J), small reproductive (SR), and large reproductive (LR) individuals. Dashed and solid arrows represent recruitment of reproductive individuals and transitions between stages, respectively. Each year, seeds can germinate (outSB) or stay in the seed bank (staySB). (a) The year of fire (TSF₀), all aboveground dewy pines are burnt, and seeds germinate from the seed bank and transition to seedlings or juveniles at TSF₁ (φ_{SB-SD} and φ_{SB-J}). (b) During the first year after fire (TSF₁), juveniles become mature (LR with a probability of φ_J or SR with a probability of $1-\varphi_J$), conditional on survival (σ_J). (c) From the beginning of the second year after fire (TSF₂) and for the remaining post-fire states until the next fire (TSF₃ and TSF_{>3}), the adult dewy pines can produce seeds (depending on the stage-specific flowering probability p_{fl} , number of flowering stalks fls , number of flowers per stalk fps ,

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and number of seeds per flower spf). The produced seeds will either go in the seed bank ($goSB$) or directly germinate into seedlings ($goCont$). In addition, adults can stay in the same stage, grow, or shrink (conditional on φ_{SR} and φ_{LR}).

References – Appendix S1

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