Main .m scripts:

Pb_foraging_dyn_prog_model_F_mat.m – creates model and solves it using backwards induction. Mater model file. Makes use of the functions in folder "functions".

params_F.m – sets parameters for SDP model

rgb.m –

Monte_carlo_execute.m – runs Monte Carlo simulations for an individual following the optimal decision rules (as determined by running pb_foraging_dyn_prog_model_F_mat.m and then using the saved workspace ResultWorkspace.mat); plots one simulation as well, with key events denoted with symbols.

Determine_scaling_factor.m – runs many (1000) Monte Carlo simulations and saves the proportion of spring days that the simulated individual spends in the active ice when she has a litter of cubs of the year. The user must then use matlab's curve fitting GUI to fit an exponential curve. The parameters of this curve are then entered in the bottom part of the script to plot the scaling factor. Creates Figure 1 in the text.

functions:

The following functions are all called by the main script pb_foraging_dyn_prog_model_F_mat.m. They can all be found in the folder "functions".

terminal_cond_F.m - sets terminal condition of SDP model

dpe_solve_F_mat – solves the stochastic dynamic programming model using backwards induction; uses linear interpolation for energetic values between discretized states

w_1_mat.m, w_2_mat.m, w_2_loss_mat.m, w_3_mat.m, w_3_loss_mat.m, w_4_mat.m – overwinter dynamics of a bear in states eta = 1, …, 4 at the end of spring; "_loss" files are for her state change if the reproductive attempt is aborted over winter

linear_interp_w_1_mat.m, linear_interp_w_2_mat.m, linear_interp_w_2_loss_mat.m, linear_interp_w_3_mat.m, linear_interp_w_3_loss_mat.m, linear_interp_w_4_mat.m - linear interpolates fitness values for overwintering functions; "_loss" files are for her state change if the reproductive attempt is aborted over winter

RMR_mat.m – calculate the total energetic losses a female bear experiences over a summer, dependent on initial energy reserves on the first day of summer. RMR for "resting metabolic rate"

Mass_mat.m – estimates a bear's mass from storage energy and length

epsilon_F_mat.m – assigns probability of mating each day in spring

Ai_F_mat.m – calculates bear's daily energy requirements

milkFun_mat.m – milk function; calculates amount of milk the female produces depending on her state

Yi_F.m – expected energy gained if a prey item is caught in each patch

stateChanges_mat.m – define daily changes in energetic state, depending on reproductive state

ValueFunctions_mat.m – calculate value functions, based on state changes and probabilities of these state changes

linear_interp_1_mat.m, linear_interp_2_mat.m, linear_interp_3_mat.m, linear_interp_4_mat.m – calculates fitness function for each possible new state; linear interpolation performed when necessary

Plotting Code:

Scripts for creating the plots and several of the results in the manuscript.

Result_plots.m – plots the results from pb_foraging_dyn_prog_model_F_mat.m; Figures 2, 5, in text and S3-S6 in Supplementary Material.

MeanState.m – 10000 Monte Carlo simulations of a 10 year old bear's energy stores throughout spring. Creates Figure 3 in text.

mean_x_1.csv – mean_x.4.csv, mean_x. csv, x_all.csv – intermediate csv files created by MeanState.m. Used for plotting Figure 3 in text, if don't want to run all 10000 Monte Carlo simulations again.

Percent_time_in_patch.m – 100 Monte Carlo simulations performed for varying lengths of spring. Used for plotting Figure 4 in text.

Perpack_COY.csv, perpack_yrl.csv – intermediate csv files created by Percent_time_in_patch.m.

Reproductive_thresholds_and_R0_against_t_breakup.m – Calculates and plots changes in the reproductive energy thresholds for varying tbreakup dates, as well as concurrent changes in the female's expected lifetime fitness. Figure 6 in text.

pregvals.csv, COYvals.csv, R0vals.csv – intermediate csv files created by Reproductive_thresholds_and_R0_against_t_breakup.m

Monte Carlo functions:

These functions are called by Monte_carl_execute.m and are required for Monte Carlo simulations.

Monte_carlo_F_mat.m – Monte Carlo simulations of an individual, assuming they make the optimal decisions at each time step

Monte_carlo_plot.m – Creates plot of one Monte Carlo simulation; Figure S2 in text.

.csv and .mat files:

scl.csv – created by Determine_scaling_factor.m

perpack.csv – created by Determine_scaling_factor.m

Initial_x.csv – Vector of initial state conditions required by Determine_scaling_factor.m; note, this csv must be strictly numeric for when it is called by other functions.

ResultWorkspace.mat – workspace and results created from pb_foraging_dyn_prog_model_F_mat.m; called by