**MATLAB codes used for modelling population dynamics with overlapping generations**

1. **Main MATLAB script**

clear all

Tend=10000; % simulation time (generations)

% Set the initial conditions

% (for both males M and females F, the values in [] correspond to genotypes AA, Aa, aa )

F=[0.1 0.2 1]; M=[0.1 0.2 1];

% Run the Model

V=NaN(Tend,6); t=1:1:Tend;

V(1,:)=[F,M];

for i=2:Tend

[F,M]=Birds\_Discrete\_Model1(F,M);

% this code calls the function 'Birds\_Discrete\_Model1'.

V(i,:)=[F,M];

end

% Plot the Results

figure(1)

plot(t,V(:,1:3),t,V(:,4:6),'--','LineWidth',2);

legend('F\_1','F\_2','F\_3','M\_1','M\_2','M\_3');

xlabel('time t'); ylabel('Population Density')

set(gca,'FontSize',15)

box on

drawnow

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1. **MATLAB function 'Birds\_Discrete\_Model1’**

function [F,M]=Birds\_Discrete\_Model1(F,M)

% this function is called from the MATLAB script 'Model1'

% Model parameters (their meaning is explained in the paper)

u=0.1;

h=0.05;

delta=0.1;

lambda=0.5;

S=@(h)sqrt(h); % the function describes effects of male care

rEPO=1.2;

N0=2;

R=1;

P=min(F(1)+F(2)+F(3),M(1)+M(2))

E=(1-u)\*(1-delta\*h);

delta1F(1)=(P\*(1-lambda)\*(1-E)\*R\*S(h)/((F(1)+F(2)+F(3))\*(M(1)+M(2))))\*(F(1)\*M(1)+F(1)\*M(2)/2+F(2)\*M(2)/4+F(2)\*M(1)/2);

delta1F(1)=(P\*(1-lambda)\*(1-E)\*R\*S(h)/((F(1)+F(2)+F(3))\*(M(1)+M(2))))\*(F(1)\*M(1)+F(1)\*M(2)/2+F(2)\*M(2)/4+F(2)\*M(1)/2);

delta1F(2)=(P\*(1-lambda)\* (1- E)\*R\*S(h)/((F(1)+F(2)+F(3))\*(M(1)+M(2))))\*(F(1)\*M(2)/2+F(2)\*M(2)/2+F(2)\*M(1)/2+F(3)\*M(1)+F(3)\*M(2)/2);

delta1F(3)=(P\*(1-lambda)\*(1-E)\*R\*S(h)/((F(1)+F(2)+F(3))\*(M(1)+M(2))))\*(F(2)\*M(2)/4+F(3)\*M(2)/2);

delta1M(1)=(P\*(lambda)\*(1-E)\*R\*S(h)/((F(1)+F(2)+F(3))\*(M(1)+M(2))))\*(F(1)\*M(1)+F(1)\*M(2)/2+F(2)\*M(2)/4+F(2)\*M(1)/2);

delta1M(2)=(P\*(lambda)\*(1-E)\*R\*S(h)/((F(1)+F(2)+F(3))\*(M(1)+M(2))))\*(F(1)\*M(2)/2+F(2)\*M(2)/2+F(2)\*M(1)/2+F(3)\*M(1)+F(3)\*M(2)/2);

delta1M(3)=(P\*(lambda)\*(1-E)\*R\*S(h)/((F(1)+F(2)+F(3))\*(M(1)+M(2))))\*(F(2)\*M(2)/4+F(3)\*M(2)/2);

tM(1)=(-P\*M(1)/(M(2)+M(1)))\*h+M(1);

tM(2)=(-P\*M(2)/(M(2)+M(1)))\*h+M(2);

tM(3)=M(3);

delta2F(1)=(P\*(1-lambda)\*(E)\*R\*S(h)\*rEPO/((F(1)+F(2)+F(3))\*(M(1)+M(2)+M(3)-h\*P)))\*(F(1)\*tM(1)+F(1)\*tM(2)/2+F(2)\*tM(2)/4+F(2)\*tM(1)/2);

delta2F(2)=(P\*(1-lambda)\*(E)\*R\*S(h)\*rEPO/((F(1)+F(2)+F(3))\*(M(1)+M(2)+M(3)-h\*P)))\*(F(1)\*tM(2)/2+F(2)\*tM(2)/2+F(2)\*tM(1)/2+F(3)\*tM(1)+F(3)\*tM(2)/2+F(1)\*M(3)+F(2)\*M(3)/2);

delta2F(3)=(P\*(1-lambda)\*(E)\*R\*S(h)\*rEPO/((F(1)+F(2)+F(3))\*(M(1)+M(2)+M(3)-h\*P)))\*(F(2)\*tM(2)/4+F(3)\*tM(2)/2+F(2)\*M(3)/2+F(3)\*M(3));

delta2M(1)=(P\*(lambda)\*(E)\*R\*S(h)\*rEPO/((F(1)+F(2)+F(3))\*(M(1)+M(2)+M(3)-h\*P)))\*(F(1)\*tM(1)+F(1)\*tM(2)/2+F(2)\*tM(2)/4+F(2)\*tM(1)/2);

delta2M(2)=(P\*(lambda)\*(E)\*R\*S(h)\*rEPO/((F(1)+F(2)+F(3))\*(M(1)+M(2)+M(3)-h\*P)))\*(F(1)\*tM(2)/2+F(2)\*tM(2)/2+F(2)\*tM(1)/2+F(3)\*tM(1)+F(3)\*tM(2)/2+F(1)\*M(3)+F(2)\*M(3)/2);

delta2M(3)=(P\*(lambda)\*(E)\*R\*S(h)\*rEPO/((F(1)+F(2)+F(3))\*(M(1)+M(2)+M(3)-h\*P)))\*(F(2)\*tM(2)/4+F(3)\*tM(2)/2+F(2)\*M(3)/2+F(3)\*M(3));

N=sum(F+M+delta1F+delta1M+delta2F+delta2M);

if N<N0

for i=1:3

F(i)=F(i)+delta1F(i)+delta2F(i);

M(i)=M(i)+delta1M(i)+delta2M(i);

end

elseif N>N0

N1=N;

for i=1:3

F(i)=(F(i)+delta1F(i)+delta2F(i))\*N0/N1;

M(i)=(M(i)+delta1M(i)+delta2M(i))\*N0/N1;

end

end

% for the non-overlapping populations one needs to replace the blue text with the following piece of text in red

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N=sum(delta1F+delta1M+delta2F+delta2M);

if N<N0

for i=1:3

F(i)=delta1F(i)+delta2F(i);

M(i)=delta1M(i)+delta2M(i);

end

elseif N>N0

N1=N;

for i=1:3

F(i)=(delta1F(i)+delta2F(i))\*N0/N1;

M(i)=(delta1M(i)+delta2M(i))\*N0/N1;

end

end