

```
%clears all variables to ensure accuracy between runs.
```

```
clearvars
```

```
%-----%  
%               Predator Prey Model 2.c               %  
%               Dakota Ewing                          %  
%-----%
```

```
%               Variables                               %  
%-----%
```

```
% To is the start month.
```

```
To = 1;
```

```
% Tf is the end month.
```

```
Tf = 500;
```

```
% dt is the time step in months.
```

```
dt = .0001;
```

```
% steps is the total number of timesteps.
```

```
Steps = (Tf - To + 1)/dt;
```

```
% T is the array in which we hold all the time values. It starts at To,
```

```
% increments by the time step, and ends at the target year, Tf.
```

```
T = To:dt:Tf;
```

```
% Yo is the starting population of Tuna.
```

```
Yo = 10000;
```

```
% Po is the starting population of Sharks.
```

```
Po = 10000;
```

```
% Ho is the population of humans, which remains constant.
```

```
Ho = 500;
```

```
% Y is the array in which we hold the number of Tuna at a given time.
```

```
% We initialize it to all zeros, except for the first month
```

```
% being simulated, which is initialized to Yo.
```

```
Y(To:Steps) = 0;
```

```
Y(To) = Yo;
```

```
% P is the array in which we hold the number of Sharks at a given time.
```

```
% We initialize it to all zeros, except for the first month
```

```
% being simulated, which is initialized to Po.
```

```
P(To:Steps) = 0;
```

```
P(To) = Po;
```

```
% H is the array in which we hold the number of Humans at a given time.
```

```
% We initialize every value to Ho, because the number of humans remains
```

```
% constant throughout the simulation.
```

```
% NOTE: This array is created to simplify the process of expanding the
```

```
% simulation to run with non-constant human populations.
```

```
H(To:Steps) = Ho;
```

```
%DHDT is the array in which we hold the change in the human population at a  
%given time step.
```

```
DHDT(To:Steps) = 0;
```

```
%Ky is the birth rate fraction of Tuna.
```

```
Ky = 2;
```

```
%Kp is the death rate fraction of Sharks.
```

```
Kp = 0.8;
```

```
%Khb is the birth rate fraction of Humans.
```

```
Khb = 0.000001;
```

```
%Khd is the death rate constant of Humans.
```

```
Khd = 0.0001;
```

```
%Kyp is the death proportionality constant of the Tuna.
```

```
Kyp = 0.0001;
```

```
%Kpy is the birth proportionality constant of the Sharks.
```

```
Kpy = 0.0002;
```

```
%Khf is the fishing rate of the Humans towards Tuna.
```

```
Khy = 0.1;
```

```
%Khf is the fishing rate of the Humans towards Sharks.
```

```
Khp = 0.1;
```

```
%                               Simulation                               %  
%-----%
```

```
t = 1;
```

```
%while the itterator is less than or equal to the total number of steps:
```

```
while t <= Steps
```

```
    %We calculate the change in Y, P and H for a dt by subtracting the  
    % number of births from the number of deaths for the species.
```

```
    %The number of births of Y is proportional to the population of Y at t.
```

```
    Ybirths = Ky * Y(t);
```

```
    %The number of deaths of Y is proportional to the number of
```

```
    % interactions between Y and P at t, plus a portion of the number of
```

```
    % interactions between H and Y at t.
```

```
    Ydeaths = Kyp * Y(t) * P(t) + Khy * Y(t) * H(t);
```

```
    dy = Ybirths - Ydeaths;
```

```
    %The number of births of P is proportional to the number of
```

```
    % interactions between Y and P at t.
```

```
    Pbirths = Kpy * P(t) * Y(t);
```

```
    %The number of deaths of P is proportional to the population of P at t,
```

```
    %plus a proportion of interactions between P and H at t.
```

```
Pdeaths = Kp * P(t) + Khp * P(t) * H(t);
dp = Pbirths - Pdeaths;

%The number of births of H is proportional to the number of
% interactions between H and the sum of Y and P at t.
Hbirths = Khb * (Y(t) + P(t)) * H(t);
%The number of deaths of H is proportional to the population of H at t.
Hdeaths = Khd * H(t);
dh = Hbirths - Hdeaths;
DHDT(t) = dt;
%The populations at t + 1 are equal to the populations at t, plus the
%change in the given population times the time step.
Y(t + 1) = Y(t) + dy * dt;
P(t + 1) = P(t) + dp * dt;
H(t + 1) = H(t) + dh * dt;

%t is incremented by 1.
t = t + 1;
end

%
%                               Plots                               %
%-----%

%plots the Y, P and H species over time.
plot(1:Steps, P(1:Steps),1:Steps, Y(1:Steps),1:Steps, H(1:Steps));

%plots the Y and P species in relation to each other.
plot(Y(1:Steps), P(1:Steps));

%prints the average growth rate of the human population over the time span.
mean(DHDT)
```