PROBLEMA 6.4 - PREY-PREDATOR MODEL

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In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
```

In [2]:
```
x_o = 1000    # conills
y_o = 40      # llops
a = 0.04      # alfa
b = 0.0005    # beta
g = 0.3       # gamma
d = 5e-5      # delta
dt = 0.01
time = np.arange(0,1000,dt)
```

In [3]:
```
def fx(x,y):
    return a*x - b*x*y

def fy(y,x):
    return -g*y + d*x*y

# Runge-Kutta
def RK4(x,y,dt,f):
    f0 = f(x,y)
    f1 = f(x+f0*dt/2, y)
    f2 = f(x+f1*dt/2, y)
    f3 = f(x+f2*dt, y)
    xt = x+dt/6*(f0+2*f1+2*f2+f3)
    return xt
```

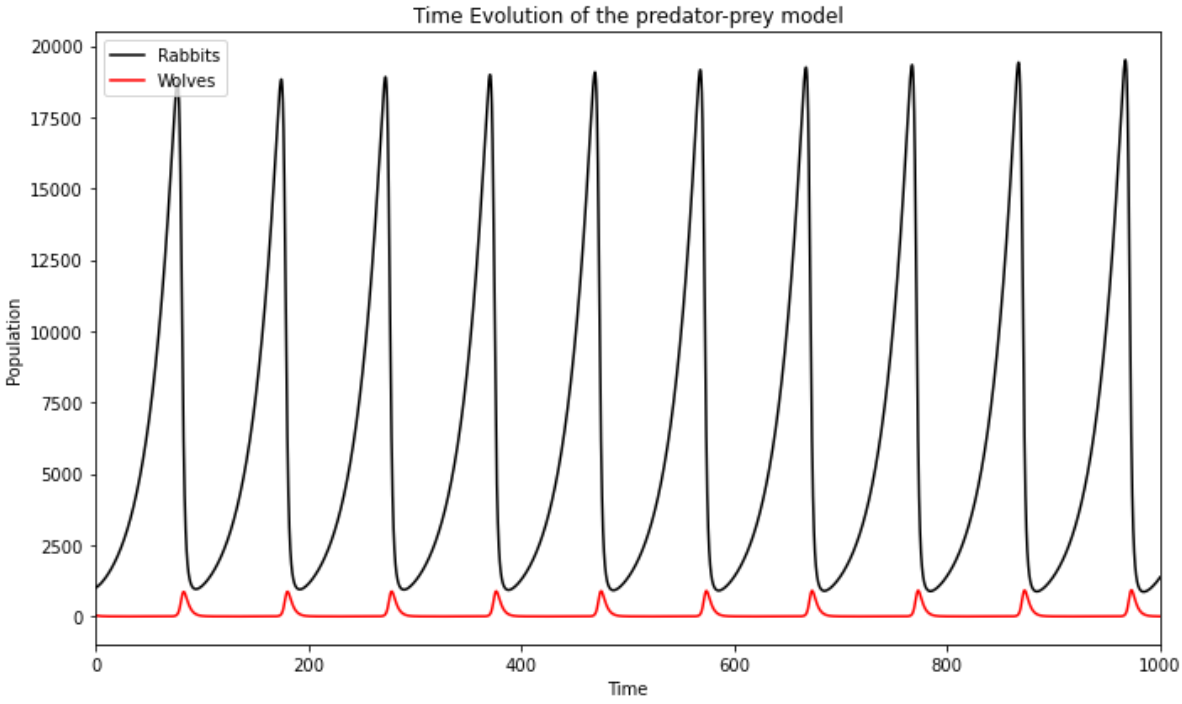
In [4]:
```
# Main loop
X = [x_o]
Y = [y_o]
for t in time:
    x_i = X[-1]
    y_i = Y[-1]
    x_next = RK4(x_i,y_i,dt,fx)
    y_next = RK4(y_i,x_i,dt,fy)
    X.append(x_next)
    Y.append(y_next)
```

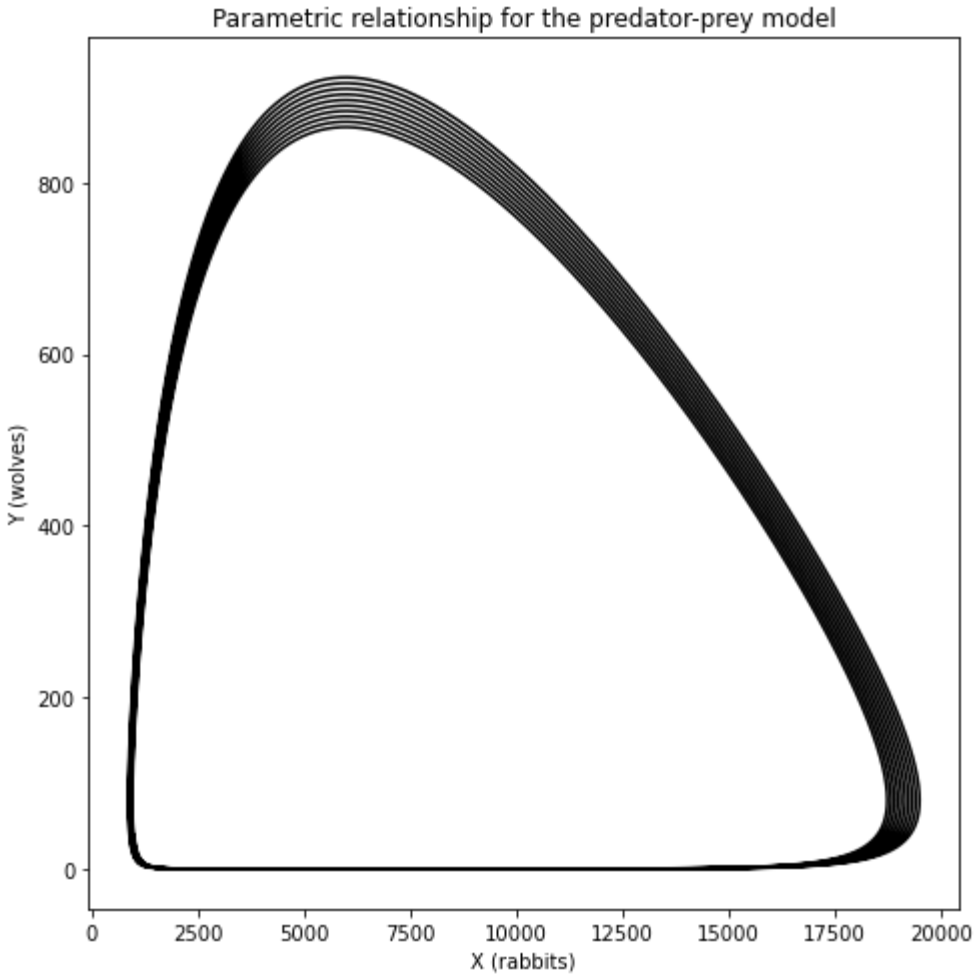
In [5]:
```
# save to file
output_data = np.column_stack((time, X[:-1], Y[:-1]))
header = "Time,    X (rabbits), Y (wolves)"
np.savetxt("6.4_predator_prey.txt", output_data, header=header, delimiter='\t', fmt
```

In [6]:

```
# Plots
plt.figure(figsize=(10, 6))
plt.plot(time,X[:-1], label="Rabbits", c="black")
plt.plot(time,Y[:-1], label="Wolves", c="red")
plt.title('Time Evolution of the predator-prey model')
plt.xlabel('Time')
plt.ylabel('Population')
plt.xlim([0,1000])
plt.legend(loc="upper left")
plt.tight_layout()
plt.show()

plt.figure(figsize=(7, 7))
plt.plot(X,Y, c="black")
plt.title('Parametric relationship for the predator-prey model')
plt.xlabel('X (rabbits)')
plt.ylabel('Y (wolves)')
plt.tight_layout()
plt.show()
```




Parametric relationship for the predator-prey model
Y (wolves)
X (rabbits)
0
200
400
600
800
0
2500
5000
7500
10000
12500
15000
17500
20000